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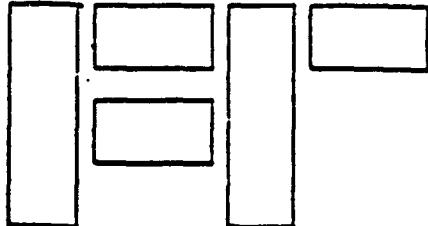
S D R E S E A R C H
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MILITARY DRESS COAT ALIGNMENT PROBLEM

PHASE I

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Cameron Station
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Garments, patterns, specifications, manufacturing processes, quality and inspection standards, and inspection procedures and tools were thoroughly reviewed. Visits to manufacturers and inspection sites were made and observations recorded. Suspicious manufacturing and inspection processes were critically scrutinized and validated.

A series of short, moderate, and long range recommendations for modifying and correcting the problems were submitted.

(U) apparel, (U) dress coat, (U) military coat,
(U) alignment

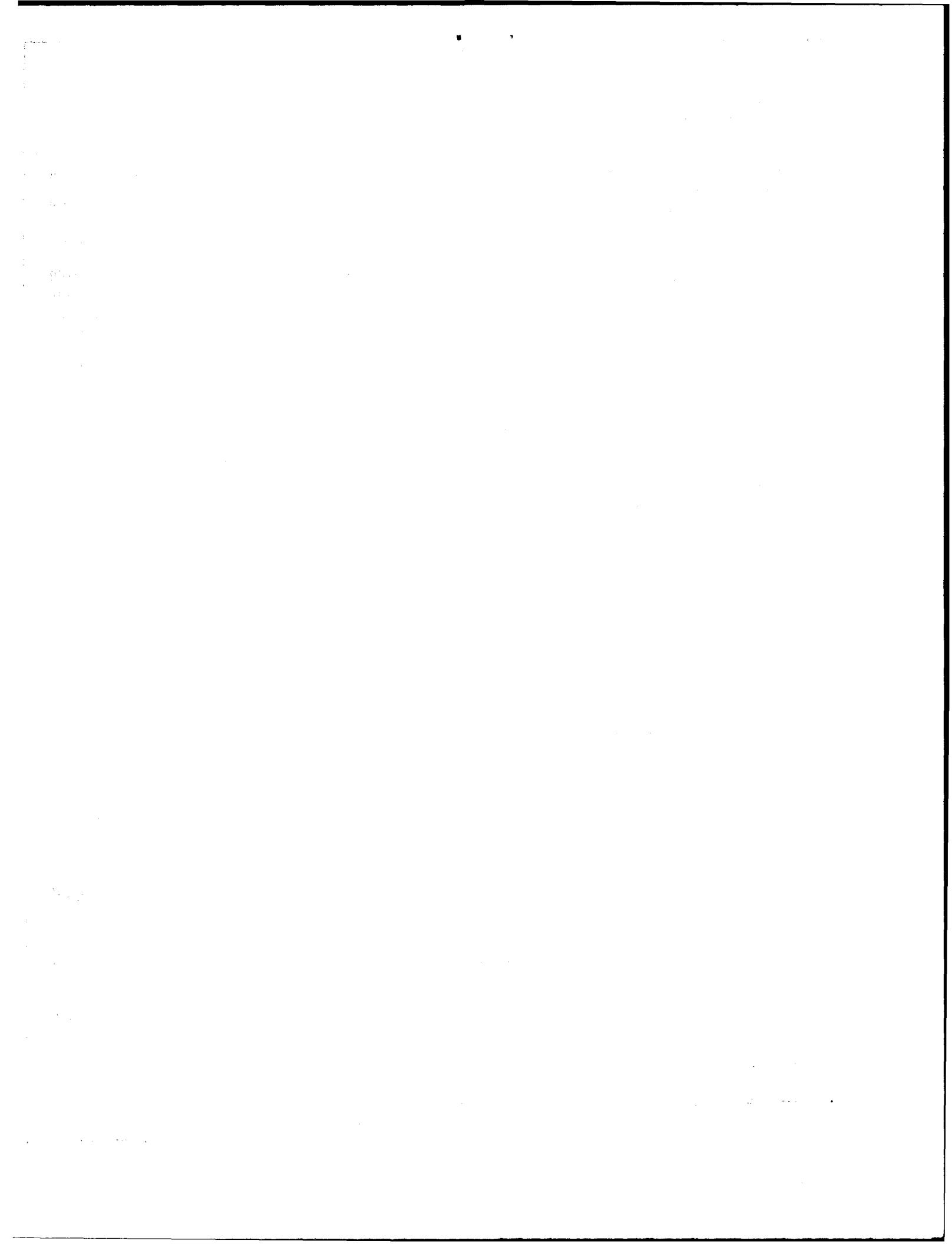
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ADVANCED APPAREL MANUFACTURING TECHNOLOGY

FASHION INSTITUTE OF TECHNOLOGY

DLA900-87-D-0016-0010



MILITARY DRESS COAT ALIGNMENT PROBLEM

PHASE I

FINAL TECHNICAL REPORT A008

Saul Smilowitz
Project Leader

September 30, 1991

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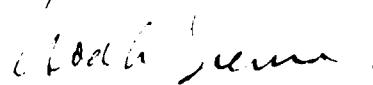
Final Report: Military Dress
Coat Alignment Problem, Phase I

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It is hereby submitted to the DLA office (DPMSO), Cameron Station, Alexandria, VA 22304-6100 in accordance with the Contract Data Requirements List, sequence A008.



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PREFACE

This project presented an age old problem that the apparel industry has long known existed. Historically, manufacturers circumvented the problem with various methods and techniques of their own devising in order to produce acceptable garments for the civilian market. The production of military dress uniforms, however, makes the problem critical because uniformity is the main and underlying factor in all military clothing requirements. In dealing with military manufacturers and contractors this uniformity requirement must be clearly specified, fully understood by all, carefully adhered to in manufacturing, and, finally, critically examined and thoughtfully approved by both manufacturer and Government representatives. Herein lies the problem: throughout every process the system relies on human factors and, thereby, is subject to human judgments. Regardless of how well-intentioned and detailed the specifications are, how precise the tools used to measure are, and how strict or lenient the inspection standards are, this uniformity problem is still subjugated to human judgments and errors.

The Government and civilian personnel we encountered during this project were extremely helpful and cooperative. All perceived and could relate to the many problems inherent in

Final Report: Military Dress
Coat Alignment Problem, Phase I

examining and inspecting military uniforms. The observations, interviews, discussions, conclusions and recommendations that derived from this project will certainly be helpful to all parties concerned. The individual problem areas were identified and detailed. The conclusions and recommendations of this report, if taken literally and implemented, can lead to the simplification and improvement of the inspection process. The recommendations are threefold: short term, medium range, long term.

The short term recommendations provide the Government with the opportunity to implement some quick changes immediately and without major costs. Basically, we found and noted some areas that can be easily improved within the present inspection framework.

The medium range recommendations will require more investigation, but since the commercial market has already begun to move in these directions the ground work has been started - inspection devices already in use by major manufacturers to check measurements and verify compliance with specifications.

Final Report: Military Dress
Coat Alignment Problem, Phase I

The third group of recommendations, long term, will require in-depth studies of electronic/mechanical processes development and devices which are proposed but not yet ready for the market.

The project as originally proposed was basically one of determining why the alignment of details on the fronts of military uniforms was as unsatisfactory as was being reported and how to effect a "quick-fix". Essentially, the problems were with the alignment of the front pockets to the front edge of the dress coats, the horizontal alignment of the pocket flaps to the pockets, and the alignment of the buttonholes to the pockets and flaps.

After observing some inspection procedures at a manufacturer/contractor, it was determined that the first stage of this project would have to be a thorough, in-depth examination of the original, hard paper patterns provided by the Government. This was necessary in order to determine the exact specified positions for the placement of the pockets and pocket flaps. These examinations were followed by detailed observations relative to manufacturing procedures in order to determine how pockets or flaps are, in practice, placed and set to the fronts. Following that, we followed the fronts through the production sequences until finished garments were finally

presented for inspection. At this point the project team carefully observed the inspection process, examined the inspection standard being used (MIL-STD-1490F), and evaluated the tools being used in the inspection process.

Upon careful analysis of the parameters of the project it became apparent to the project team that a logical order of investigation would encompass:

The model forms used to inspect the garments

The tools used for the inspecting and/or measuring

The inspection technique itself

The Government standard used, and it's interpretation

The qualifications of the Quality Assurance Representatives relative to subjectivity/objectivity of inspections

The manufacturing techniques employed at the manufacturer/contractor locations

Final Report: Military Dress
Coat Alignment Problem, Phase I

After isolating these six areas we proceeded to move along, taking into consideration each of these points in our observations and interviews.

Saul Smilowitz
Saul Smilowitz
Project Leader

September 30, 1991

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Final Report: Military Dress
Coat Alignment Problem, Phase I

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TABLE OF CONTENTS

	<u>Page</u>
AUTHORIZATION	i
PREFACE	ii
ACKNOWLEDGEMENTS	v
TABLE OF CONTENTS	vii
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF DIAGRAMS	x
INTRODUCTION	1
PROJECT PURPOSE	1
PROJECT ANALYSIS	1
PROJECT ACTIVITIES	2
IDENTIFICATION OF PROBLEM AREAS	3
Model Forms	3
"T" Square	7
MIL-STD-1490F	9
Manufacturing Techniques	17
Marking Techniques (Marine Corps Coats)	17
Marking Techniques (Army and Air Force Coats)	20
Sewing	20
INSPECTION TECHNIQUES	21
RECOMMENDATIONS	22
Model Forms	22
"T" Square	23
MIL-STD-1490F	23
Manufacturing Techniques	54
SUMMARY	55
RECOMMENDATIONS	56
Short Term Recommendations	57
Model Forms	57
"T" Square	57
MIL-STD-1490F	57
Manufacturing Techniques	58
Medium Range Recommendations	59
Long Term Recommendations	59

Final Report: Military Dress
Coat Alignment Problem, Phase I

LIST OF TABLES

	<u>Page</u>
TABLE I: Model Form Measurements (Marine Corps) . . .	4
TABLE II: Model Form Measurements (Army, Air Force) .	5

LIST OF FIGURES

	<u>Page</u>
Figure I - "T" Square	8
Figure II - Horizontal Alignment of Breast Pockets . .	12
Figure III - Outside Corners of Breast Pocket are Out of Alignment	14
Figure IV - All Points in Alignment	15
Figure V - Horizontal Alignment of Top Button to Breast Pocket Flap Buttons	25
Figure VI - Alignment of Top Front Button to Breast Pocket Buttons	27
Figure VII - Top Front Button Out of Alignment With Left Breast Pocket Button	28
Figure VIII - Top Front Button Out of Alignment With Right Breast Pocket Button	29
Figure IX - Top Front Button Out of Alignment With Right and Left Breast Pocket Buttons	30
Figure X - Measurements of Flaps.	33
Figure XI - Placement of Patch and Welt Pockets	35
Figure XII - Vertical Alignment of Breast Pockets With Front Edges of the Flaps of the Lower Patch Pockets	37
Figure XIII - Slope of Lower Patch Pocket	39
Figure XIV - Centering Point of Breast Pocket Flaps . .	41
Figure XV - Inside Corners of Breast Pocket Flaps in Alignment, Outside Corners Out of Alignment	43
Figure XVI - Inside Corners of Breast Pocket Flaps in Alignment, Flaps Rounded	45
Figure XVII - Recommended Measurements to Determine Horizontal Alignment of Breast Pocket Flaps	46
Figure XVIII - Top Edge of Breast Pocket Flaps at Right Angles with Front Edge of Coat When Buttoned	48
Figure XIX - Recommended Measurements to Determine Parallelism of Breast Pockets to Front Edge of Coat	51
Figure XX - Position of Bottom Front Buttonhole	53

Final Report: Military Dress
Coat Alignment Problem, Phase I

LIST OF DIAGRAMS

	<u>Page</u>
Diagram A: Marking wtih Powder	24
Diagram B: Marking with Negative Patterns . .	25

INTRODUCTION

Uniformity of dress uniform appearance and satisfactory or acceptable alignment of pockets, buttons, lapels, etc., on coats and jackets have been long-standing problems for the military services. Inspectors of finished garments have tried to grapple with these problems in several ways, none of which have proven to be completely satisfactory.

The problem of uniformity and alignment of garment details is acute with the Marine Corps dress uniform coats. It is somewhat less severe in the case of the coats of the other services.

It is currently conceded by military Quality Assurance Representatives (QAR's) and garment manufacturers that the currently specified inspection techniques and tolerances do not yield acceptable results: some garments that have passed the inspection process appear, upon subsequent review, to have alignment problems. Also, some garments from the same production lot that have failed inspection do not display any uniformity or alignment problems when reexamined.

PROJECT PURPOSE

The purpose of this project was to identify the problems relating to the horizontal and vertical alignment of the pockets, pocket flaps, buttons, and buttonholes, and also the "gapping" and lack of uniform appearance of the collars and lapels on the Group A military dress coats. Also, the project was intended to investigate whether or not any of the same factors kept occurring, regardless of where or in which section of the country the garments were inspected. Although MIL-STD-1490F, Military Standard, Provisions for Evaluating Quality of Coats, Men's, Dress, is very precise in its format, the project team also intended to determine if there were any problems with interpretation of its procedures on the part of the Quality Assurance Representatives in the field as it was felt that this also could have an effect upon the project's results.

PROJECT ANALYSIS

The research team determined that the alignment problem could be narrowed down to six areas -

1. The model forms used to examine finished coats
2. The tools used to measure alignment
3. The inspection procedure
4. The interpretation of MIL-STD-1490F
5. The subjectivity/objectivity of the QAR's
6. Differences in manufacturing techniques.

PROJECT ACTIVITIES

The research team visited seven QAR/manufacturing sites:

Arien Fashions
Vineland, New Jersey

Cavalier Manufacturing
Jamaica, New York

Defense General Supply Center
Richmond, Virginia

Defense Personnel Support Center
Memphis, Tennessee

Defense Personnel Support Center
Philadelphia, Pennsylvania

Lanier Clothes
Fayetteville, Alabama

Stanley Blacker Mfg.
Philadelphia, Pennsylvania

The project team has studied the problems in detail and its findings and recommendations appear in the remainder of this report which has been divided into two sections:

Final Report: Military Dress
Coat Alignment Problem, Phase I

Identification of Problem Areas; and, Recommendations.

Diagrams appear throughout this report in order to clarify the text.

IDENTIFICATION OF PROBLEM AREAS

In the opinion of the project team, the problem areas that exist relative to horizontal alignment of pockets and pocket flaps, parallelism of breast pockets to fronts, vertical alignment of breast pockets to lower pocket flaps, and alignment of top front buttons with breast pocket flap buttons are as follows: the model forms; the "T" Square; MIL-STD-1490F; and, manufacturing and inspection techniques. Each of the problem areas is discussed separately.

MODEL FORMS

Model forms are utilized to inspect the finished coats for examination of defects XI through XVII listed in Table III of MIL-STD-1490F. Tables I and II of the Standard, duplicated here, list the size model forms that are utilized for the various size garments. It also lists the chest, waist, and seat-hip measurements for each of the model forms. There is a tolerance of plus or minus 1/2" on all measurements.

TABLE I
MODEL FORM MEASUREMENTS
(Marine Corps)

COAT SIZE	MODEL FORM SIZE	CHEST	WAIST	SEAT HIP
30-32	30	32	26	32
33-34	32	34	28	34
35-36	34	36	30	36
37-38	36	38	32	38
39-40	38	40	34	40
41-42	40	42	36	42
43-44	42	44	38	44
46	44	46	40	46

Final Report: Military Dress
Coat Alignment Problem, Phase I

TABLE II
MODEL FORM MEASUREMENTS
(Army, Air Force)

COAT SIZE	MODEL FORM SIZE	CHEST	WAIST	SEAT-HIP
30-31	30	32	26	32
32-33	32	34	28	34
34-35	34	36	30	36
37-38	36	38	32	38
38-39	38	40	34	40
40-41	40	42	36	42
42-43	42	44	38	44
44-45	44	46	40	46
46-47	46	48	42	48
48-50	48	50	44	50

The model forms that are used to evaluate the finished garments present unusual situations. For instance, one size form is used to examine six different size coats. The three companies that construct the forms meet the required measurements for waist, chest, and seat-hip. However, the slopes of the models from each of the companies are different. In addition, there are no reference points other than the center front and neckline seams to assist in the positioning of the coats on the models for inspection. The condition of the models relative to their state of repair also presents a problem.

There is no distinction in MIL-STD-1490F between extra short, short, long, or extra long garments as to which model size to use. For example, when examining a size 37 extra short on a size 36 model as specified, the coat fits very tight and is distorted. Experienced QAR's recognize the problem and use their own initiative to work around this situation. However, inexperienced inspectors follow the Military Standard line-for-line and may fail a garment that may have nothing wrong with it.

In addition, different model forms (forms produced by different manufacturers) are utilized when inspecting the garments. These are produced by Wolf, Superior, and Bauman, three independent companies, and are different in slopes. For

Final Report: Military Dress
Coat Alignment Problem, Phase I

example, the chest in the Superior form is more forward than the other two and this results in the coat being forced forward which distorts its appearance and can affect the alignment. The hip measurement is wider on the Wolf form than on the Superior form. The Superior form also gives the appearance of being slightly "humped" in the back. The use of different manufacturers' forms at different locations can account for the fact that a coat can pass examination in one location but fail in another.

Although there is a prescribed method of dressing the forms with a finished coat for inspection, it was observed that some Quality Assurance Representatives put the coats on the forms differently than others. This also could affect the final results. The project team found, by experimentation, that if certain coats have failed inspection they could be replaced on the form in a slightly different manner and, thereby, pass inspection. The team also did the reverse, placing a coat that passed inspection on the form in a somewhat modified manner which resulted in a failed garment. This tended to confirm our convictions concerning the subjectivity of the inspection process.

"T" SQUARE

The "T" Square that is issued by the Defense Personnel Support Center (DPSC) and utilized by the inspectors to measure the vertical and horizontal alignment of the pockets, pocket flaps, buttons, and buttonholes is a pliable plastic device, smoke gray in color, with red or yellow markings (Figure I).

It is the project team's opinion that there are too many lines on this device. This poses an impediment to the inspectors who wish to obtain accurate readings. The smoke gray color of the device makes it very difficult to see the components of the garment through it. The device with the yellow markings is virtually impossible to use, particularly when measuring the horizontal alignment of the breast pockets. The markings completely obscure the upper portion of the pockets, thereby making it extremely difficult to obtain an accurate measurement. In fact, it was found that some inspectors couldn't obtain any measurements at all with this instrument.

In visits to the various inspection/manufacturing sites, we observed that there was an absence of uniformity in the utilization of the "T" Squares by the inspectors. Some of the inspectors inverted the device, some used it right side up, while others used it sideways.

Final Report: Military Dress
Coat Alignment Problem, Phase I

FIGURE I
"T" SQUARE

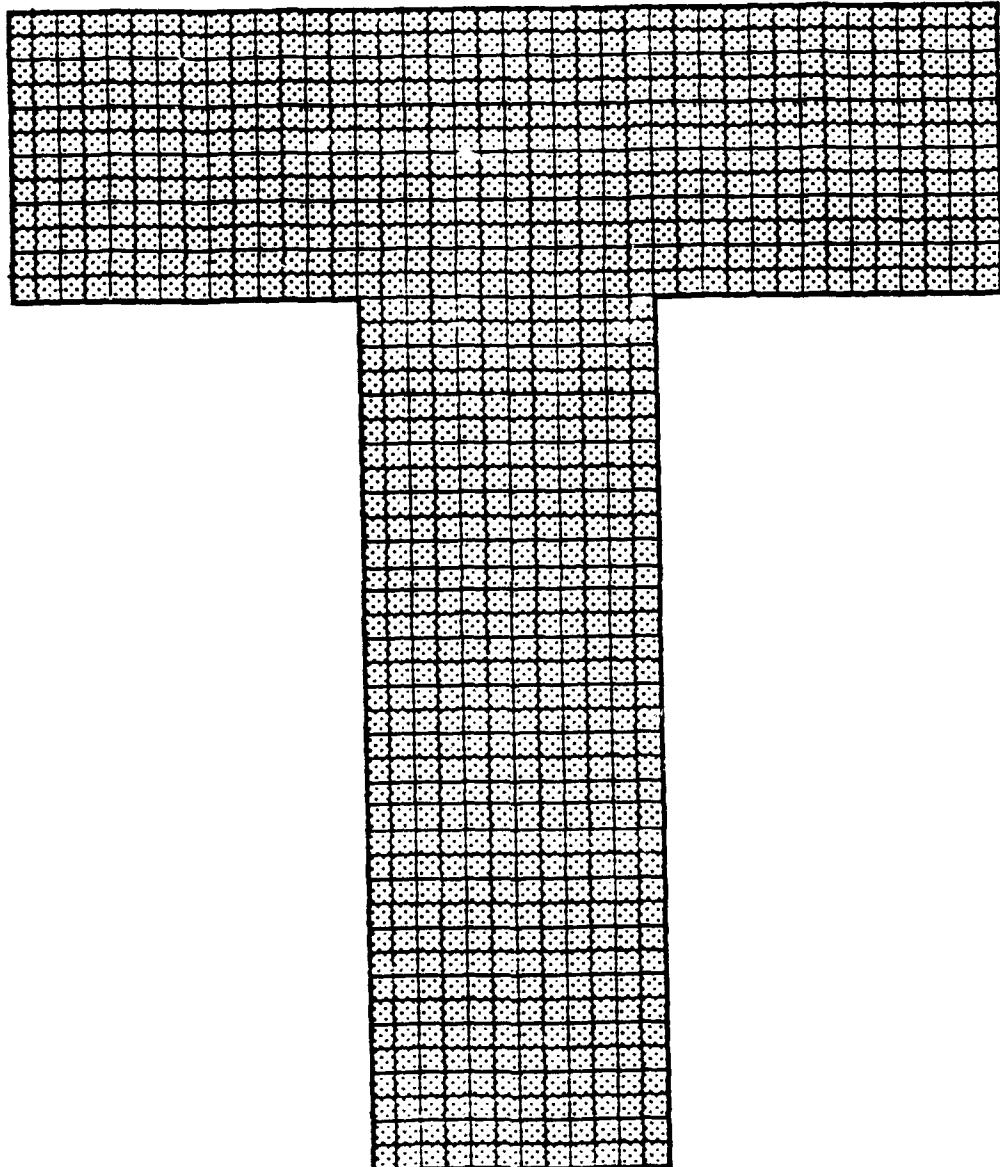


FIGURE I
"T" SQUARE

MIL-STD-1490F

It is the opinion of the project team that MIL-STD-1490F, as regards alignment, is not easily understood. We have read and reread this document and have arrived at different interpretations several times. Obviously, the inexperienced inspector will also have a difficult time interpreting this document. Also, we feel that there is a lack of diagrams to illustrate the various measurements which are required. In our visits to inspection sites we discovered other problems with MIL-STD-1490F which are discussed below. Quotes are from the document itself.

1. "XI. ALIGNMENT OF FRONT BUTTON OR BUTTONHOLE
 - a. Top front button or buttonhole of Group A coat out of horizontal alignment with breast pocket flap buttons:
 1. by more than 1/2"....(*selected defect)
 2. by more than 3/8" but not more than 1/2"....3 points"

This section would be easier to measure if it was accompanied by a diagram.

Final Report: Military Dress
Coat Alignment Problem, Phase I

* * *

2. "XIII. POCKET OR FLAP

a. Misshapen or distorted - any point varying:

1. More than 1/4" from specified dimension or with corresponding point on finished shaper....(*selected defect)
2. 1/8" up to 1/4" (inclusive) from specified dimension or with corresponding point on finished shaper....3 points"

(A shaper is a pattern or template against which a finished part is measured.)

The term pocket or flap is singular. Is the Standard referring to the left or the right pocket, or both? Obviously, the Standard is referring to both flaps/pockets, but it should be so stated.

* * *

3. "XIII. POCKET OR FLAP

c. Out of alignment or misplaced by:

1. All coats except Group A Marine Corps coats:
(See Note 3, below)
 - a. more than 3/8"....(*selected defect)
 - b. more than 1/4" up to 3/8" inclusive....3 points
 - c. 1/8" up to 1/4" inclusive....2 points

Note 3. The following focal points shall be measured in the examination for this condition:

1. Flap: top corner of flap nearest front edge of coat and front edge of flap just before the curved corner.
2. Patch pocket: bottom of straight edge nearest front edge of coat.
3. Welt pocket: top corner of pocket nearest front edge of coat."

This section is extremely confusing. What is "out of alignment" in reference to? Misplaced relative to the patterns? We are not sure! A more detailed explanation is required in this section.

* * *

4. "2. Group A Marine Corps coats only: (See Note 4, below)
 - a. more than 3/16"

Note 4.

1. Front edge of breast pocket not in vertical alignment with the front edge of the lower flap. (*selected defect)

2. Upper front corner of lower patch pocket not set back 1/8" and the lower corner of the pocket not set back 3/8" from the above vertical alignment. (*selected defect)

Again there is the problem of ambiguity. Is the lower flap mentioned in Note 4.1 the flap of the pocket on the lower portion of the coat? Is the left flap or right flap the one to be measured? This section should be specific with no room for individual interpretation. A diagram would be most beneficial in this case. Also, Note 4.2 reads "lower corner of the pocket not set back 3/8" from the above vertical alignment." Which vertical alignment is it referring to? When the inspectors illustrated the method used to measure this defect we were amazed. We would have never measured this particular item in the manner that was demonstrated. A diagram would be extremely helpful in this case!

* * *

5. "XIII. POCKET OR FLAP

e. Breast pocket flap: Group A coat

4. Flap not in horizontal alignment
 - a. more than 1/4" (*selected defect)
 - b. more than 1/8" up to 1/4" inclusive....3 points"

The Standard doesn't state exactly what portions of the flaps are to be measured. Is it every portion of the flaps? Is it the outside corners? Is it the top middle of the flaps? Needless to say, we found this very confusing. Upon consulting the applicable specification, MIL-C-24924(MC), we found that the answers appear on page 81. When asked, the inspectors instructed us to align the inside top corners of the breast pocket flaps to determine compliance (see Figure II, HORIZONTAL ALIGNMENT OF BREAST POCKETS). However, the outside corners of the flaps are not measured. This means that the outside corners of the pockets could be out of alignment, and the garment could still pass this portion of the inspection. Figure III, OUTSIDE CORNERS OF BREAST POCKETS OUT OF ALIGNMENT, is an illustration of this point: The inside top corners are in alignment but the outside corners are not. Should this garment be accepted? We think not!

FIGURE II
HORIZONTAL ALIGNMENT
OF BREAST POCKETS

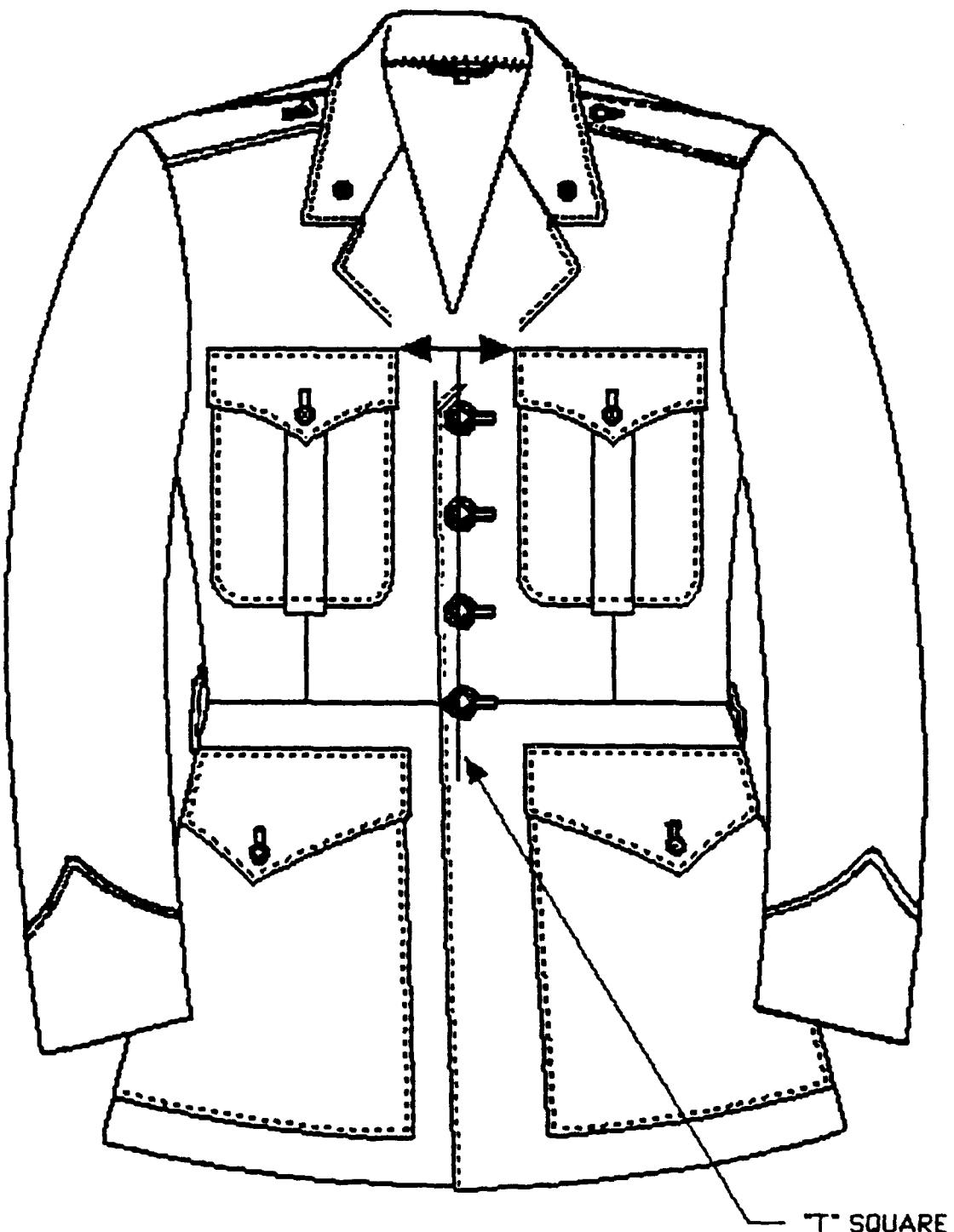


Figure IV, ALL POINTS IN ALIGNMENT, IS THAT ACCEPTABLE? is another example of a coat that will meet the criteria of this portion of the standard. In this particular illustration, all parts of the flaps match. However, common sense dictates that this garment is unacceptable relative to horizontal alignment of the breast pocket flaps.

* * *

6. "XIII. POCKET OR FLAP

f. Breast pocket: Group A coat

1. Side pocket not parallel with front edge of coat by: (see Note 5, below)
 - a. more than 3/8"....3 points
 - b. 1/4" up to 3/8"....2 points

Note 5. Measure from straight front edge of coat to front edge of pocket at top (immediately below flap), and also at bottom of pocket. Any difference between measurements is the amount pocket is not parallel with front edge."

Is the Standard referring to the breast pocket or the lower side pocket? Line f. specifies Breast pocket while subline 1. specifies side pocket. This is confusing and seems contradictory. In our opinion a drawing should accompany the written portion of the Standard to clearly illustrate what is meant.

FIGURE III
OUTSIDE CORNERS OF BREAST
POCKETS OUT OF ALIGNMENT

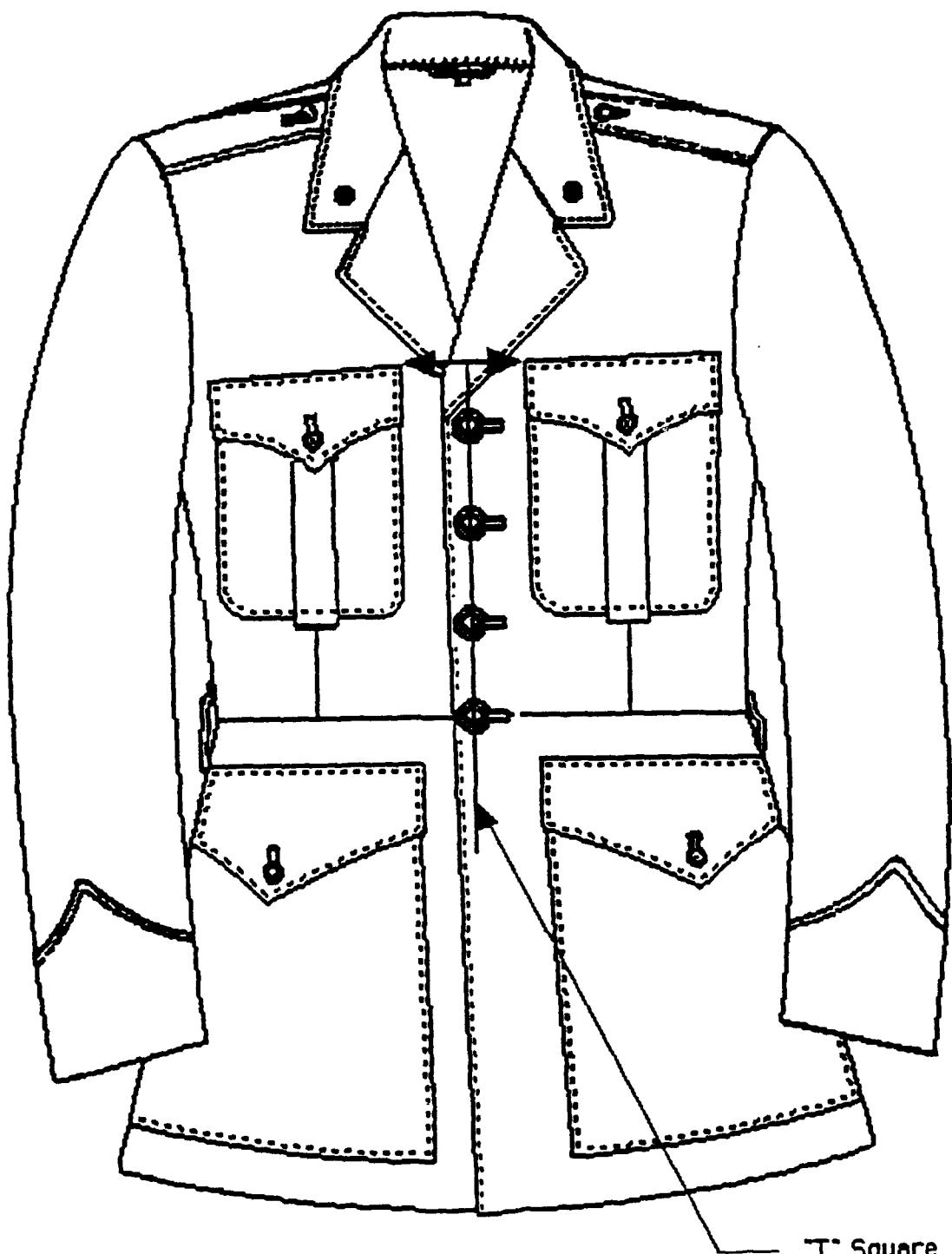
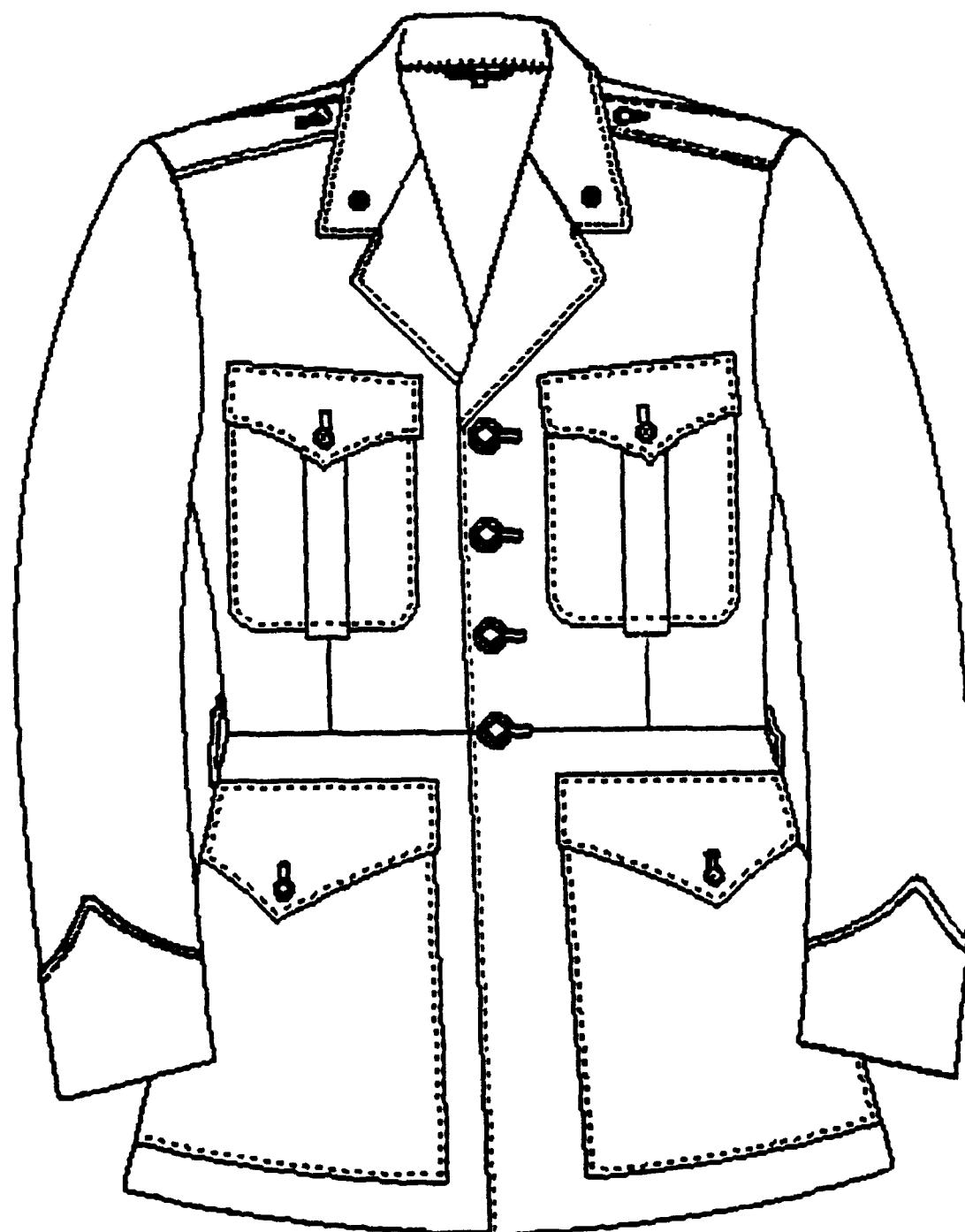


FIGURE IV
ALL POINTS IN ALIGNMENT
IS THAT ACCEPTABLE?



* * *

7. "XIV LAPEL OR COLLAR

- a. Misshapen or distorted - any point varying 1/4" or more with corresponding point on finished shaper....(*selected defect)
- b. Not uniform in size or shape - any point varying:
 - 1. More than 5/16" with corresponding point on matching part....(*selected defect)
 - 2. More than 1/4" but not more than 5/16" with corresponding point on matching part....3 points
 - 3. More than 1/8" but not more than 1/4" with corresponding point on matching point....2 points"

The shaper becomes wrinkled or misshapen very easily due to the pliability and softness of the material from which it is made. This results in the inspectors experiencing difficulties when trying to obtain a reading. In addition, there is the probability that the reading obtained is erroneous. Again, this can account for the same coat passing inspection in one location and failing in another.

* * *

There are references to various footnotes throughout MIL-STD-1490F. In this document the practice is to place the footnotes on the back pages. This tends to confuse, mislead, and be time consuming as one flips back and forth through the document for the footnotes. Also, errors can be made in interpretation when flipping back and forth between pages. Footnotes should be placed at the bottom of the page or as close to the text as possible. For example, on pages 26, 27, and 28 of the Standard there are various notes referring to defects and focal points, some of which are to be measured. If each of these notes were on the same page as where it is applicable, the sections would be easier to comprehend and would enable the inspectors to perform their work more efficiently.

It is noted that MIL-STD-1490F does not address the horizontal alignment of the breast pocket flaps of the Army and Air Force garments. The specifications state that the bottom buttonhole shall be positioned 3/4 inch to one inch above the top edge of the lower pocket flaps. However, there isn't any provision for checking this in the Standard.

MANUFACTURING TECHNIQUES

Marking Techniques (Marine Corps Coats)

During the project team's visits to the manufacturing sites various methods of marking the pockets were observed. They were as follows:

- a. Because the Marine Corps coat front has a waist seam, the patterns for the front (from waist to shoulder, "upper front") and the skirt (waist to hem, "lower front") were used separately by some firms in order to locate the top and bottom pocket positions. The pocket outline, instead of being cut out of the pattern, was perforated with holes. Chalk powder was forced through the holes in order to outline the pocket on the garment. See Diagram A, MARKING WITH POWDER.

- b. Another firm used full front patterns (from shoulder to hem) for locating the top and bottom pocket positions. The outlines of the pockets were cut out of the patterns (negative patterns). The worker used a white tailor's marking pencil to trace around the opening, thereby marking the pocket locations on the garment. See Diagram B, MARKING WITH NEGATIVE PATTERNS.

- c. A third method, similar to the first, utilized separate front and skirt patterns. However, the pocket outlines were removed from the patterns creating negative patterns for pocket locations. A tailor's marking pencil was used to trace around the pocket outlines.
- d. There is also a fourth technique which is being used. Instead of the pocket outlines consisting of holes, as in the first method, slits are used to mark the pocket placements.

It is the opinion of the project team that the use of perforated patterns and chalk powder is not an effective method for marking the pocket locations. The perforations in the patterns tend to quickly clog with chalk and the powder dissipates very rapidly from the surface of the cloth. In addition, as the garment piece is moved about in production, the powder will tend to shift, creating potential pocket placement error.

DIAGRAM A

MARKING WITH POWDER

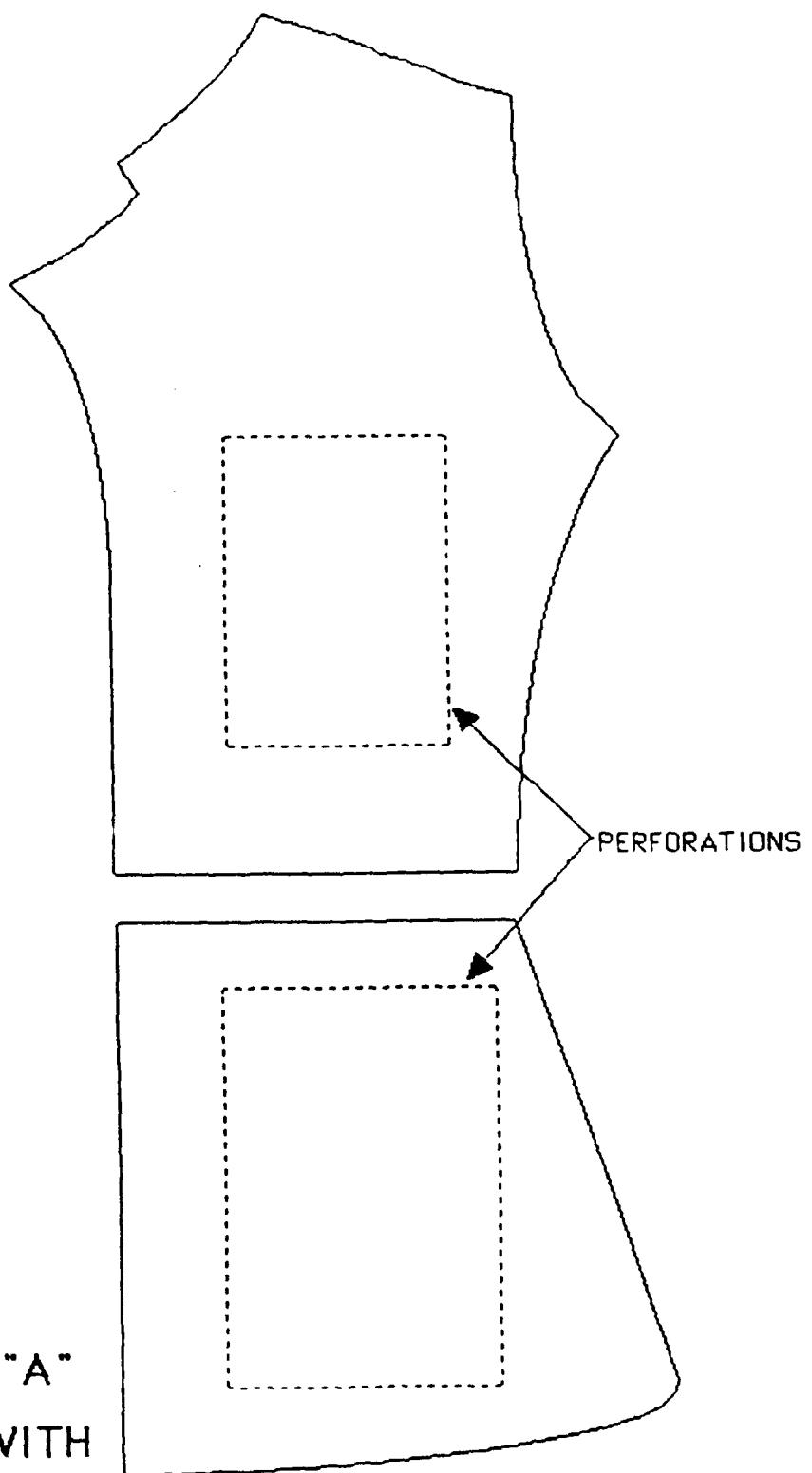
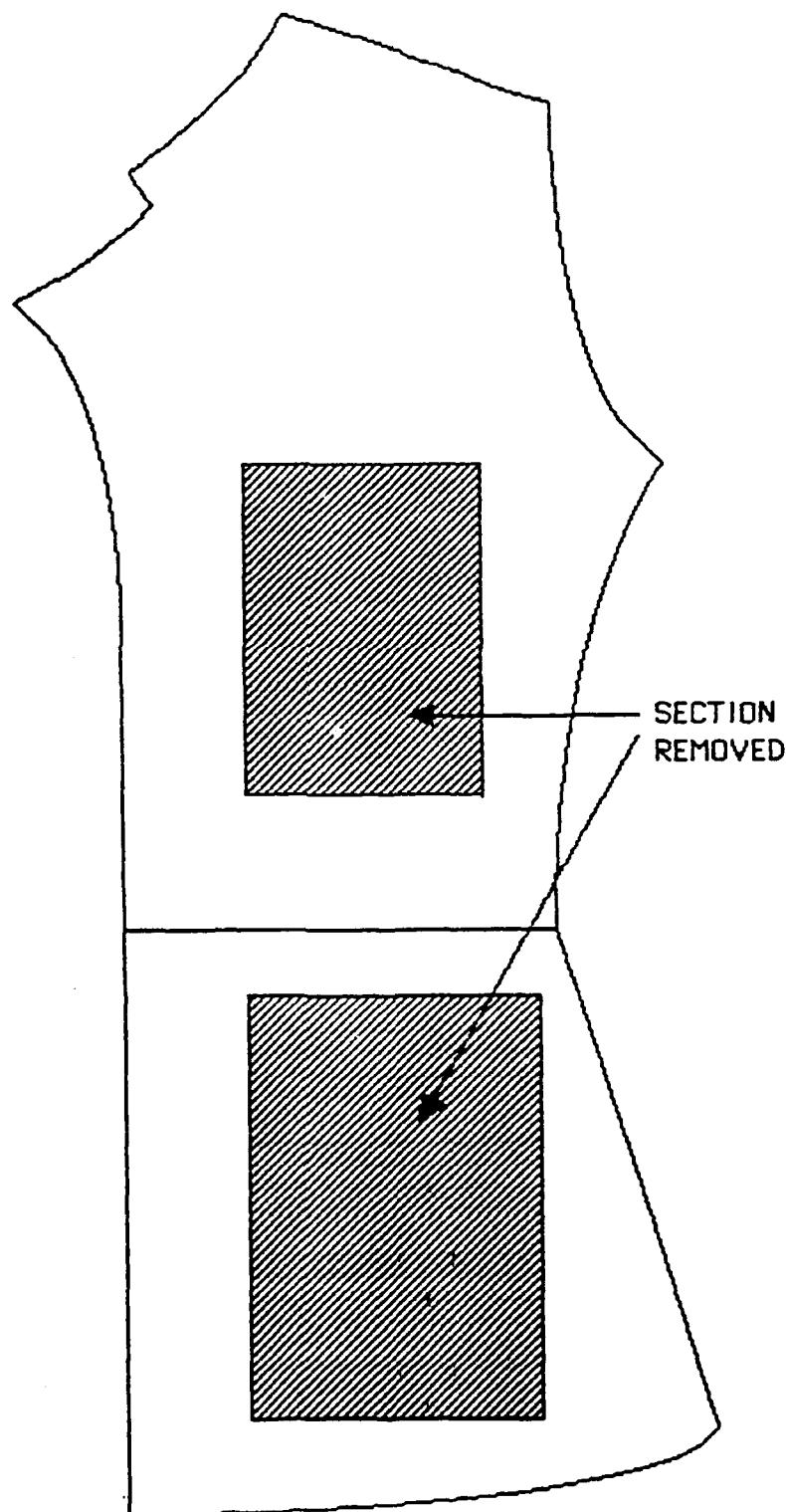


DIAGRAM "A"
MARKING WITH
POWDER

DIAGRAM B

MARKING WITH NEGATIVE PATTERNS



Marking Techniques (Army and Air Force Coats)

Since both the Army and Air Force coats have full fronts, unlike the Marine Corps coat which has a waist seam, the marking procedure utilizes full front patterns (from shoulder to hem) for locating the top and bottom pocket positions. The outlines of the pockets were cut out of the patterns (negative patterns) or lines indicating pocket and flap positions (slits) were cut out of the patterns. The personnel doing the marking traced the outline of the pocket or slits using white tailor's chalk or a chalk pencil to indicate these positions on the coat fronts. See Diagram B, MARKING WITH NEGATIVE PATTERNS.

At each contractor it was observed that the Standard Patterns furnished by the Government had been copied in order to produce working patterns. Although this procedure is specifically approved in the specifications of the Marine Corps, the Army, and the Air Force dress coats, it must be realized that when copies are made of Standard Patterns the potential does exist for creating errors. This is especially true when the contractors are copying the patterns to make their marking slopers.

Sewing

There is virtually no difference in the sewing methods used to produce the three service's coats. There are only two construction differences: one is the waist seam on the Marine Corps coat versus the Army and Air Force coats that have solid fronts; the other difference is the double welt pocket under the lower flaps on the Army and Air Force coats.

The project team found practically no difference in the methods used to sew the pockets. Extreme caution, however, must be taken by the operator when setting the flaps on the double welt Army and Air Force dress coat pockets. He/she must make sure the edge of the flap is set parallel to the top edge of the pocket. This is a case where precision and proper sewing technique is of the utmost importance.

In our plant visits we found nothing being done incorrectly in either the sewing of the pockets or the flaps. Although there are machines available which could automatically sew the pockets to the fronts, their use would not necessarily solve the problem of alignment: an operator would still be required to put the pocket in the correct location prior to setting.

Final Report: Military Dress
Coat Alignment Problem, Phase I

The project team encountered no problems dealing with the lapels or collars in any of the three garments studied. The collars were observed being measured for equality of length as were the spaces between collar and lapels on the Marine Corps and Air Force coats. All measuring by the Quality Assurance Representatives was done with metal rulers. In some cases, where the contractors' inspection personnel had a language or reading problem, a homemade device was used to examine finished coats even though the devices are not officially approved by the QAR's.

INSPECTION TECHNIQUES

The basic prescribed inspection technique for dress coats is as follows. The finished coat is put on the form determined by MIL-STD-1490F (see Tables I and II). The coat is then aligned so that the left and right collar and lapel seams are both the same distance from the neckline seam of the form. The coat is buttoned closed and the buttons are positioned in the eyes of the buttonholes. The coat is then positioned again, making sure it is centered on the form using the center front seam of the form as a visual checkpoint for a line running through the center of the front buttons. When the Quality Assurance Representative is satisfied that the garment is properly positioned it is ready to be examined.

Most of the QAR's perform an initial visual inspection. Then, if necessary, they use some type of measuring device to confirm their judgments as to alignment. If the garment is deemed satisfactory on initial visual inspection the QAR then proceeds to inspect the next garment. Any borderline cases are checked for measurements using the "T" square or a metal ruler, which is a more objective analysis than the basically subjective inspection used in the initial, visual go-around.

It was noted that the more experienced QAR's tended to examine the coats faster than the less experienced QAR's and they more frequently passed garments on the basis of their visual examinations alone instead of measuring every detail.

RECOMMENDATIONS

MODEL FORMS

Coat sizes that are extra short, short, long, and extra long are currently being inspected on model form sizes as specified in MIL-STD-1490F (See Tables I and II). This procedure should be changed as the current model forms are either too long or too short for these sizes which results in distortion of the garments and leads to erroneous alignment inspection results. Experiments should be conducted to determine whether the size

Final Report: Military Dress
Coat Alignment Problem, Phase I

model forms specified are the most appropriate ones for the particular sizes of extra short, short, long, and extra long or whether the use of other size model forms would create less distortions.

As mentioned previously, the model forms produced by the different manufacturers are not identical. They have the same chest, waist, and seat-hip measurements for each particular size, but the slopes, the inclination of the back of the model forms to the vertical plane, vary. The model forms used for inspection of military dress coats should be identical in every aspect. In addition, it is recommended that model forms should be developed which more accurately depict the current shape of the human military body. These changes would eliminate a lot of the variability in results when utilizing the present forms for inspection.

Currently, there are no reference points on the model forms to ensure the proper placement of the coats on the forms. This frequently results in inspectors placing the coats on the model form differently, again resulting in different outcomes of the inspection process. We strongly recommend the placement of additional reference lines on the model forms so that all inspectors can place the coat on the form in exactly the same manner and position.

Consideration should be given to establishing a program whereby the Government purchases inspection model forms produced to its specifications and then leases, sells, or otherwise provides these forms to the then current contractors who would be held responsible for their proper maintenance and upkeep.

"T" SQUARE

The "T" Square currently utilized by the inspectors is smoke gray in color. This makes it very difficult to see the garment being inspected. The "T" Square should be made of a clear, colorless plastic so as to afford maximum transparency.

Also, the current yellow markings on the "T" Square make it extremely difficult if not impossible to measure the green Marine Corps coat. The markings on the "T" Square should be of a color to afford the best visibility to the inspectors. Black may be the correct color. In addition, markings on the device should be limited to those necessary for military coat inspections so as to eliminate as much confusion as possible. There should also be a short training program or training manual prepared for the inspectors which instructs them as to the most efficient techniques for utilizing the "T" Square.

Final Report: Military Dress
Coat Alignment Problem, Phase I

MIL-STD-1490F

It is the opinion of the project team that, wherever possible, the written portion of Military Standard, Provisions for Evaluating Quality of Coats, Men's, Dress (MIL-STD-1490F) should be supplemented with additional diagrams and additional explanatory text to decrease the interpretive action by the inspectors. Diagrams accompanied by qualifying text would make it easier for the inspectors to understand the provisions of the Standard and would better describe exactly what measurements they are required to make. Diagrams could also illustrate examples of coats which do not meet the criteria of the Standard.

The following cases exemplify the needs and benefits of this recommendation.

* * *

In the section dealing with the alignment of the front buttons to buttonholes the Standard states:

"XI. ALIGNMENT OF FRONT BUTTON OR BUTTONHOLE

- a. Top front button or buttonhole of Group A coat out of horizontal alignment with breast pocket flap buttons:

1. by more than 1/2"....(*selected defect)
2. by more than 3/8" but less than 1/2"....3 points.

This particular section refers to all garments - Marine Corps, Army, and Air Force. Figure V: HORIZONTAL ALIGNMENT OF TOP FRONT BUTTON TO BREAST POCKET FLAP BUTTONS illustrates an Army/Air Force garment in which the top front button is in perfect horizontal alignment with the breast pocket flap buttons. A diagram such as this should be included in MIL-STD-1490F and accompany the text as it would present a much clearer picture of what is required.

* * *

Figures VI through IX represent examples of the Marine Corps dress coat and address the topic of horizontal alignment of the top front button to the breast pocket flap buttons. These diagrams could also be used to illustrate the Army/Air Force coats. The project team strongly recommends the inclusion of these or similar diagrams in future editions of MIL-STD-1490F.

FIGURE V

HORIZONTAL ALIGNMENT OF TOP FRONT BUTTON
TO BREAST POCKET FLAP BUTTONS

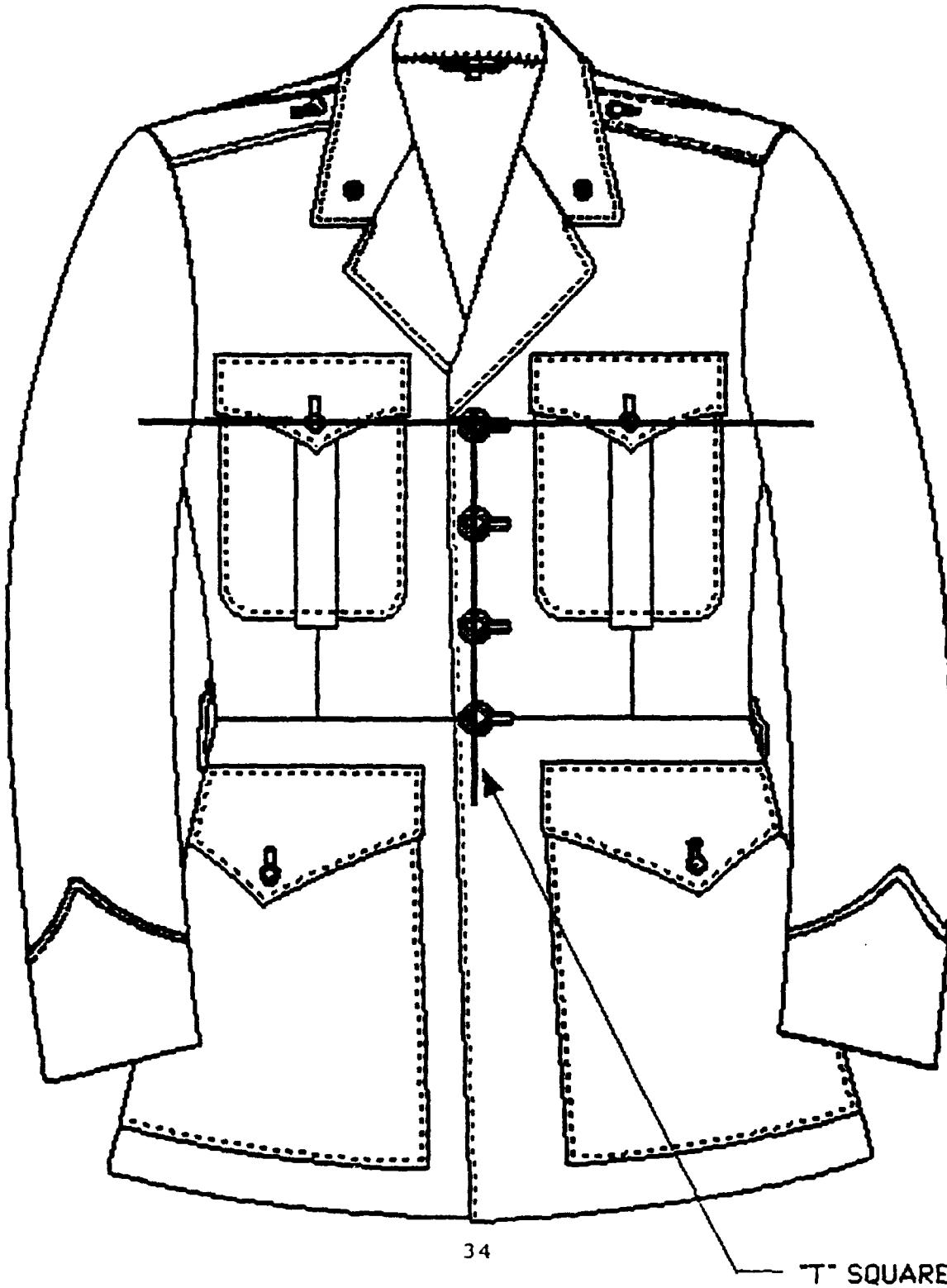


Figure VI: ALIGNMENT OF TOP FRONT BUTTON TO BREAST POCKET BUTTONS would give a clear and precise picture of a garment with these buttons in perfect alignment.

Figure VII: TOP FRONT BUTTON OUT OF ALIGNMENT WITH LEFT BREAST POCKET BUTTON illustrates a garment in which the top front button is not in horizontal alignment with the left (garment left) breast pocket button. This situation could be reversed wherein the right breast pocket button could be out of alignment as illustrated in Figure VIII: TOP FRONT BUTTON OUT OF ALIGNMENT WITH RIGHT BREAST POCKET BUTTON; or both buttons could be out of alignment with the top front button as shown in Figure IX: TOP FRONT BUTTON OUT OF ALIGNMENT WITH RIGHT AND LEFT BREAST POCKET BUTTONS.

Inclusion of the following texts along with their corresponding illustrations would also be very helpful.

For Figures VII and VIII

- a) If "Y" is greater than 1/2", then a selected defect exists.
- b) If "Y" is more than 3/8" but less than 1/2", then 3 defect points are assigned.
- c) If "Y" is less than 3/8", then no defect points are assigned.

FIGURE VI
ALIGNMENT OF TOP FRONT BUTTON TO
BREAST POCKET BUTTONS

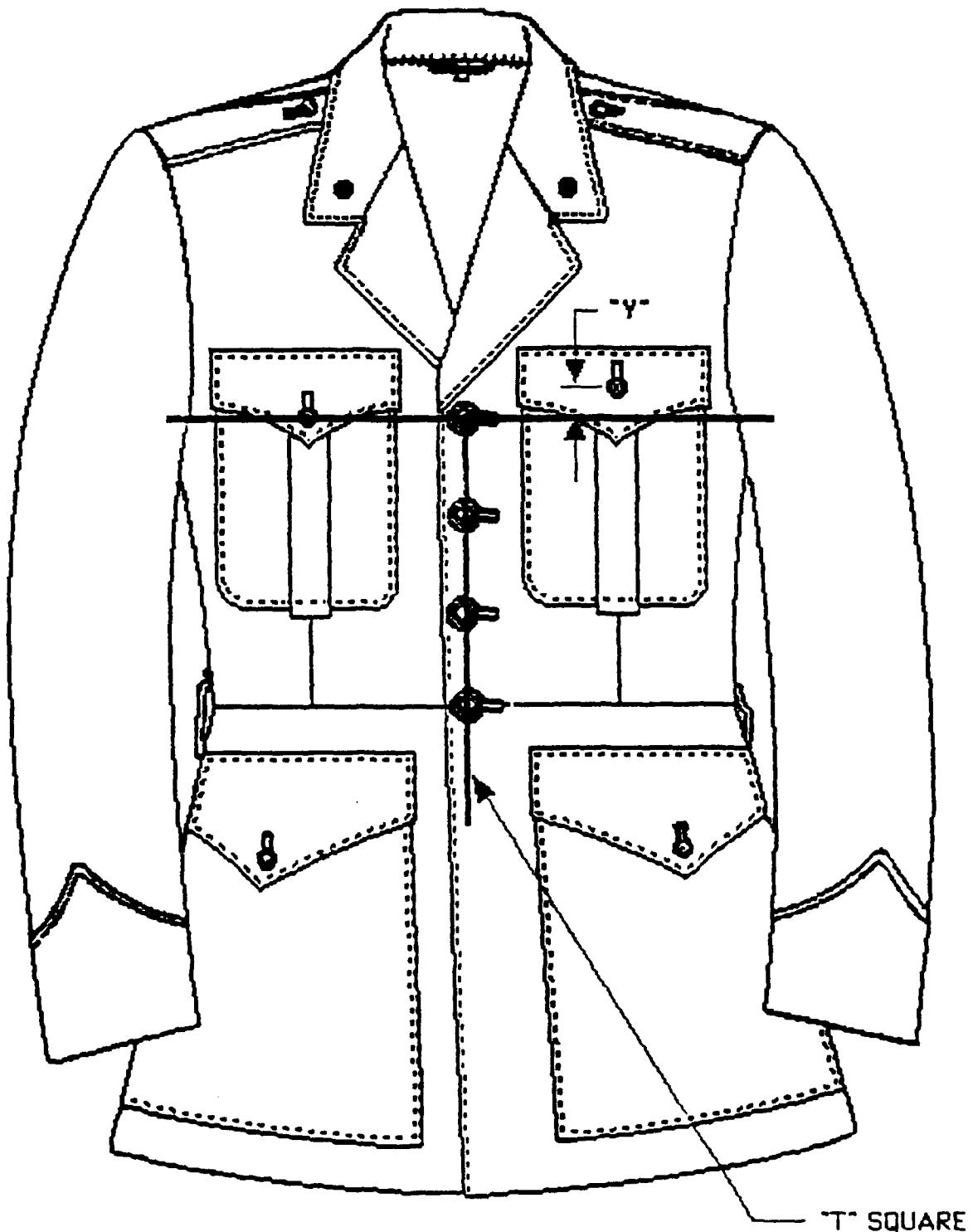


FIGURE VII
TOP FRONT BUTTON OUT OF ALIGNMENT
WITH LEFT BREAST POCKET BUTTON

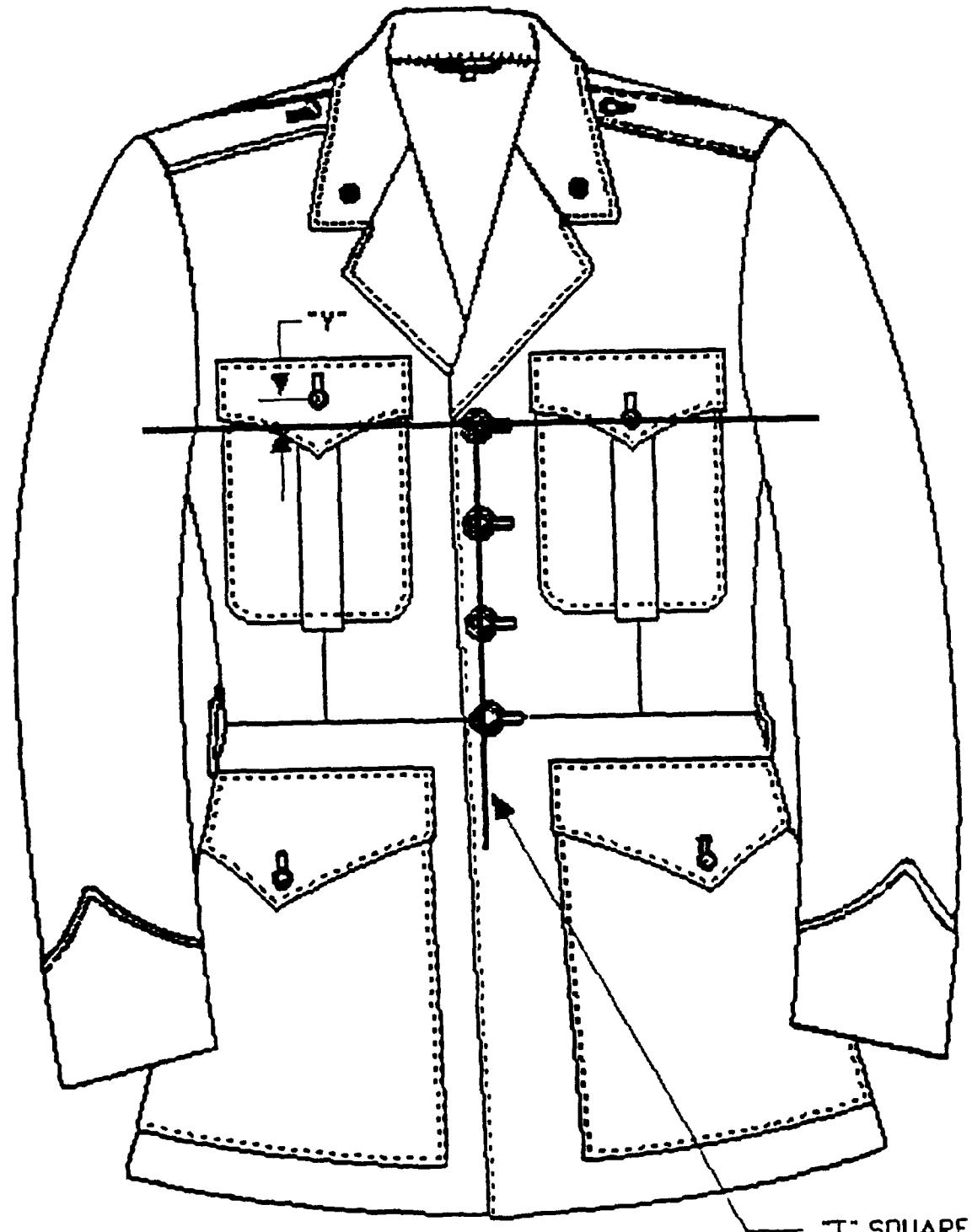


FIGURE VIII
TOP FRONT BUTTON OUT OF ALIGNMENT WITH
RIGHT BREAST POCKET BUTTON

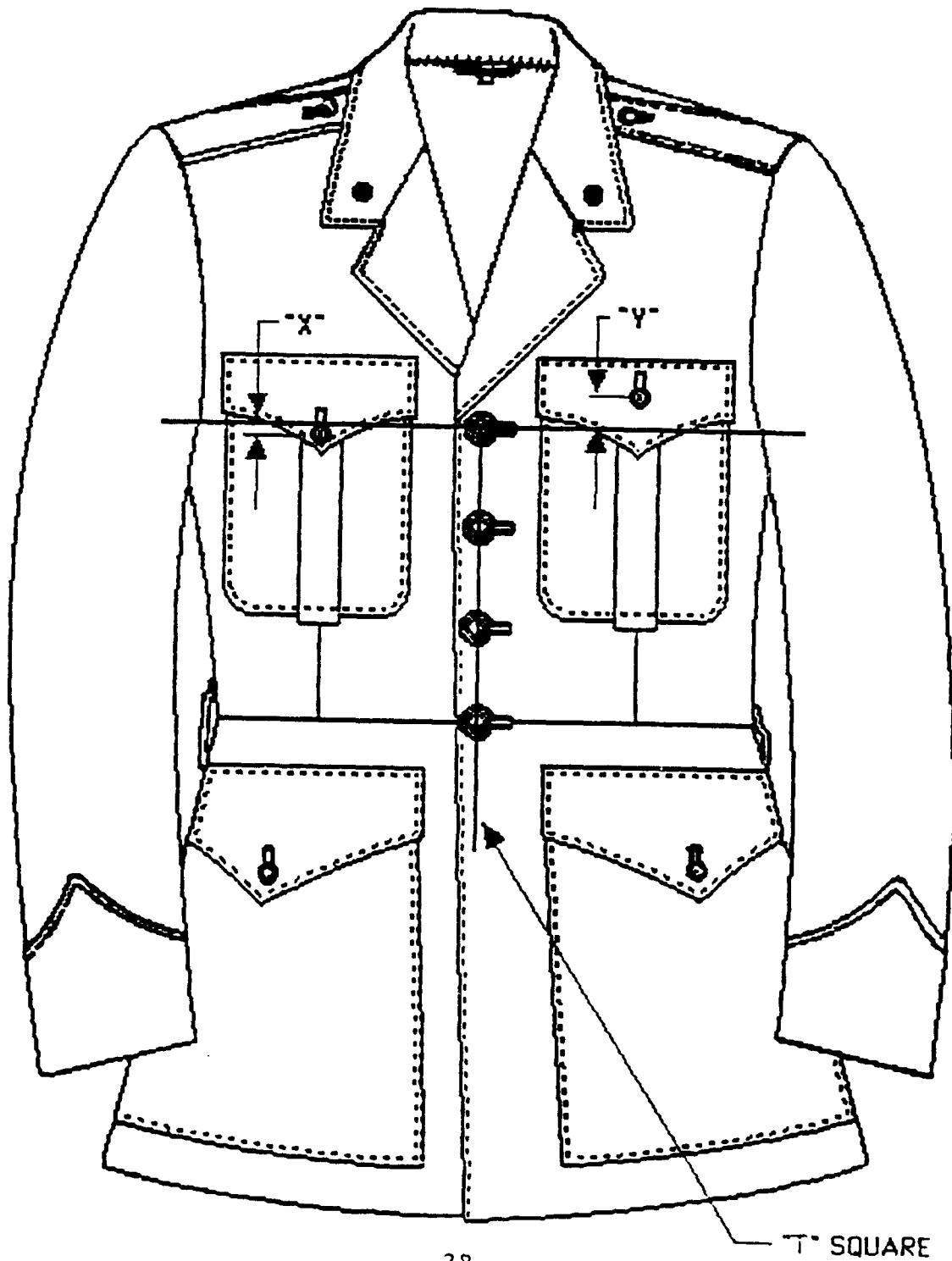
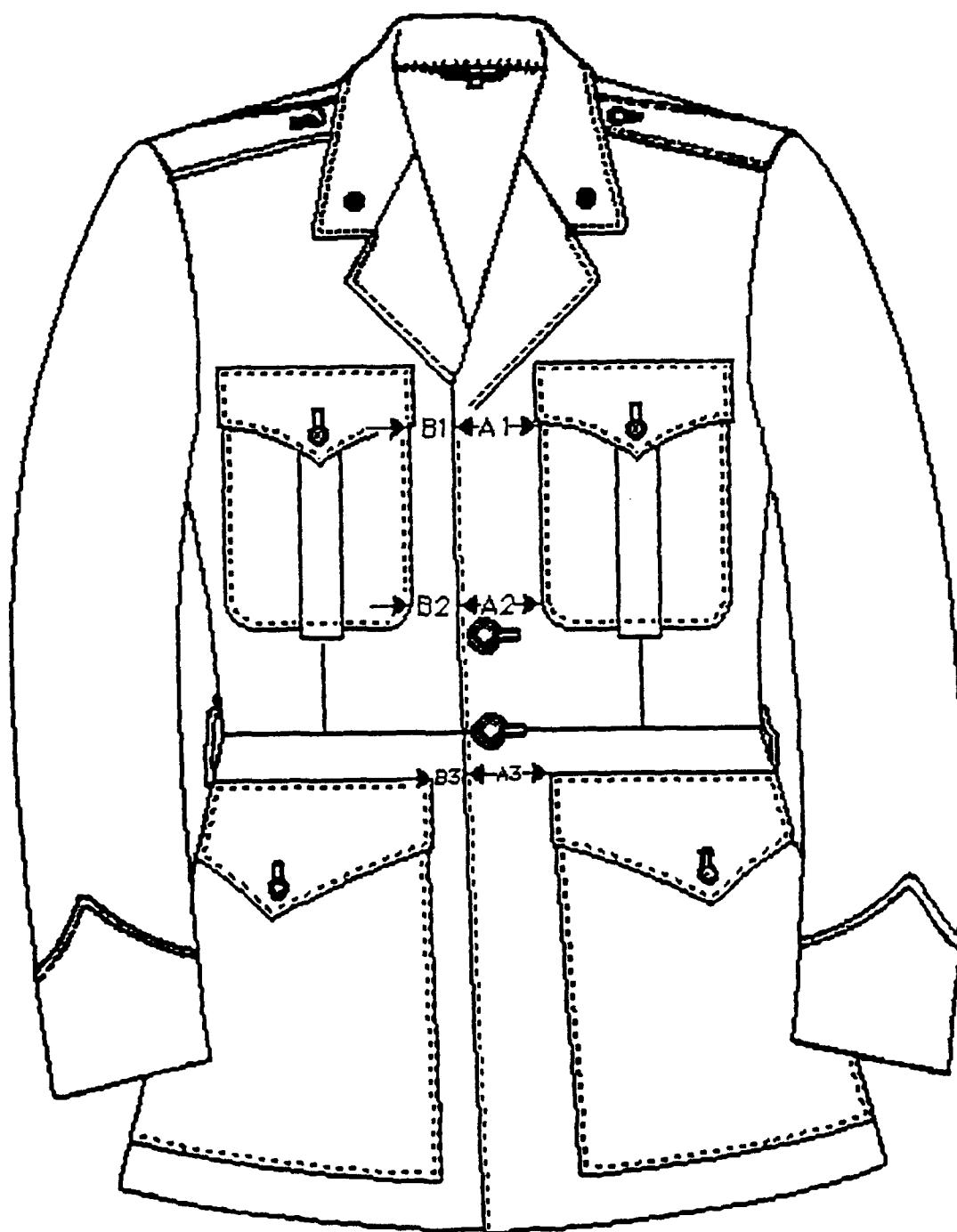


FIGURE IX

TOP FRONT BUTTON OUT OF ALIGNMENT
WITH RIGHT AND LEFT BREAST POCKET BUTTONS



For Figure IX

- a) If X or Y is greater than 1/2", then a selected defect exists.
- b) If X or Y are more than 3/8" but less than 1/2", then 3 defect points are assigned.

In this illustration X could be 7/16" and Y could be 5/16", resulting in the pockets not being in horizontal alignment with the top front button and the coat would be assigned three defect points. However, relative to each other, the breast pockets would be out of horizontal alignment by 3/4". The project team believes that this would be totally unacceptable and, therefore, the Standard should be revised to include the difference between the left and right breast pockets. For example, the Standard could state that if X varies from Y by a specific amount (to be determined), then a selected defect exists. Also, if X varies from Y by a specific but lesser amount (to be determined), then a three point defect exists, etc.

* * *

Another example where a diagram would be helpful is the section of the Standard referring to the pocket or flap alignment. It states:

XIII. POCKET OR FLAP

c. Out of alignment or misplaced by:

1. All coats except Group A Marine Corps coats:
(see Note 3)
 - a. more than 3/8"....(*selected defect)
 - b. more than 1/4" up to 3/8" inclusive....3 points
 - c. 1/8" up to 1/4" inclusive....2 points

Note 3. The following focal points shall be measured in the examination for this condition:

1. Flap: top corner of flap nearest front edge of coat and front edge of flap just before the curved corner.
2. Patch pocket: bottom of straight edge nearest front edge of coat.
3. Welt pocket: top corner of pocket nearest front edge of coat.

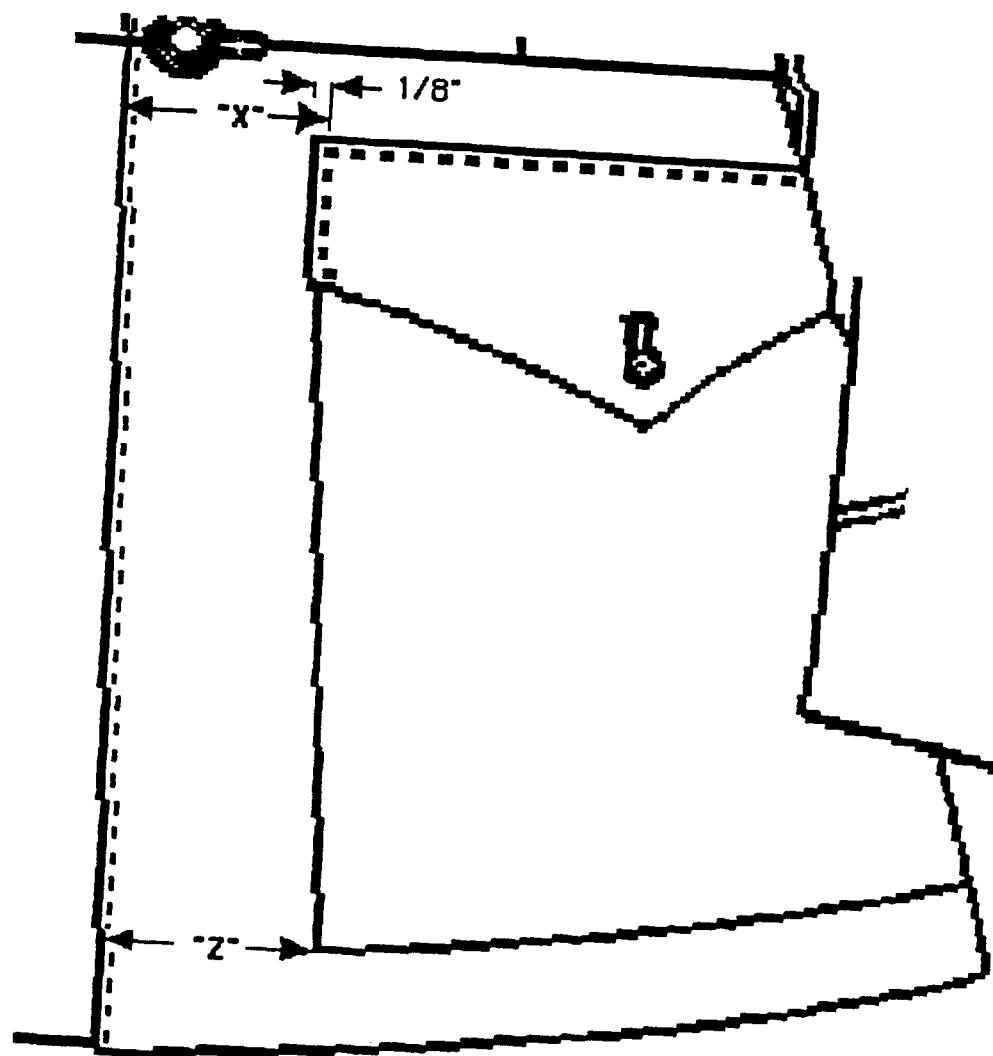
This section would certainly be easier to comprehend if it was accompanied by a diagram such as Figure X: MEASUREMENT OF FLAPS. The accompanying text for Note 3.1, Flap, could read as follows:

Final Report: Military Dress
Coat Alignment Problem, Phase I

- a) If $A=B$, or if A does not vary from B by more than $1/8"$, then no defect points are assigned.
- b) If A varies from B by $1/8"$ to $1/4"$ inclusive, then 2 defect points are assigned.
- c) If A varies from B by $1/4"$ to $3/8"$ inclusive, then 3 defect points are assigned.
- d) If A varies from B by more than $3/8"$, then a selected defect exists.

FIGURE X

MEASUREMENT OF FLAPS



For Notes 3.2 and 3.3, patterns are required. However, if we assume the measurements to be X and Y, then Figure XI: PLACEMENT OF PATCH AND WELT POCKETS can be utilized to illustrate the proper inspection technique as follows.

- a) If X and Y do not vary by more than 1/8", then no defect points are assigned.
- b) If X and Y vary by 1/8" to 1/4" inclusive, then 3 defect points are assigned.
- c) If X and Y vary by 1/4" to 3/8" inclusive, then 3 defect points are assigned.
- d) If X and Y vary more than 3/8", then a selected defect exists.

* * *

Another example:

XIII. POCKET OR FLAP

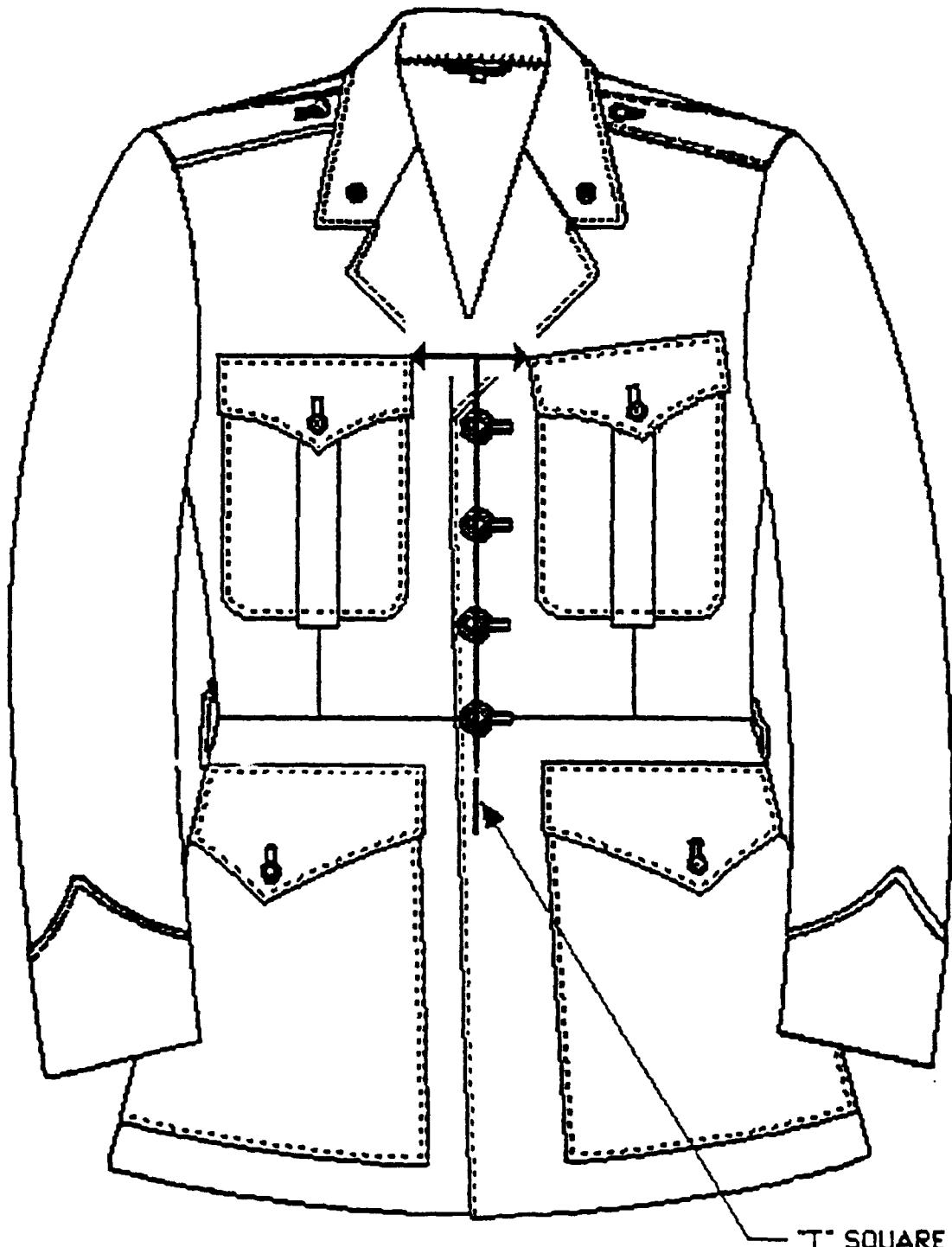
- c. Out of alignment or misplaced by:
 - 2. Group A Marine Corps coats only:
(see Note 4.)
 - a. more than 3/16"....(*select defect)

Final Report: Military Dress
Coat Alignment Problem, Phase I

Note 4. 1. Front edge of breast pocket not in vertical alignment with the front edge of the lower flap.

2. Upper front corner of lower patch pocket not set back 1/8" and the lower corner of the pocket not set back 3/8" from the above vertical alignment.

FIGURE XI
PLACEMENT OF PATCH
AND WELT POCKETS



A problem with this requirement is that it doesn't state whether it is referring to the left or right pocket. In Section XIII the terms POCKET OR FLAP are singular, not plural. This can confuse the inspectors and lead to a contradiction of results. The statement would be clearer if accompanied by a diagram such as Figure XII: VERTICAL ALIGNMENT OF BREAST POCKETS WITH FRONT EDGE OF THE FLAPS OF THE LOWER PATCH POCKETS. Figure XII illustrates quite clearly what measurements are to be taken, assuming that both pockets are to be measured. The accompanying text should read:

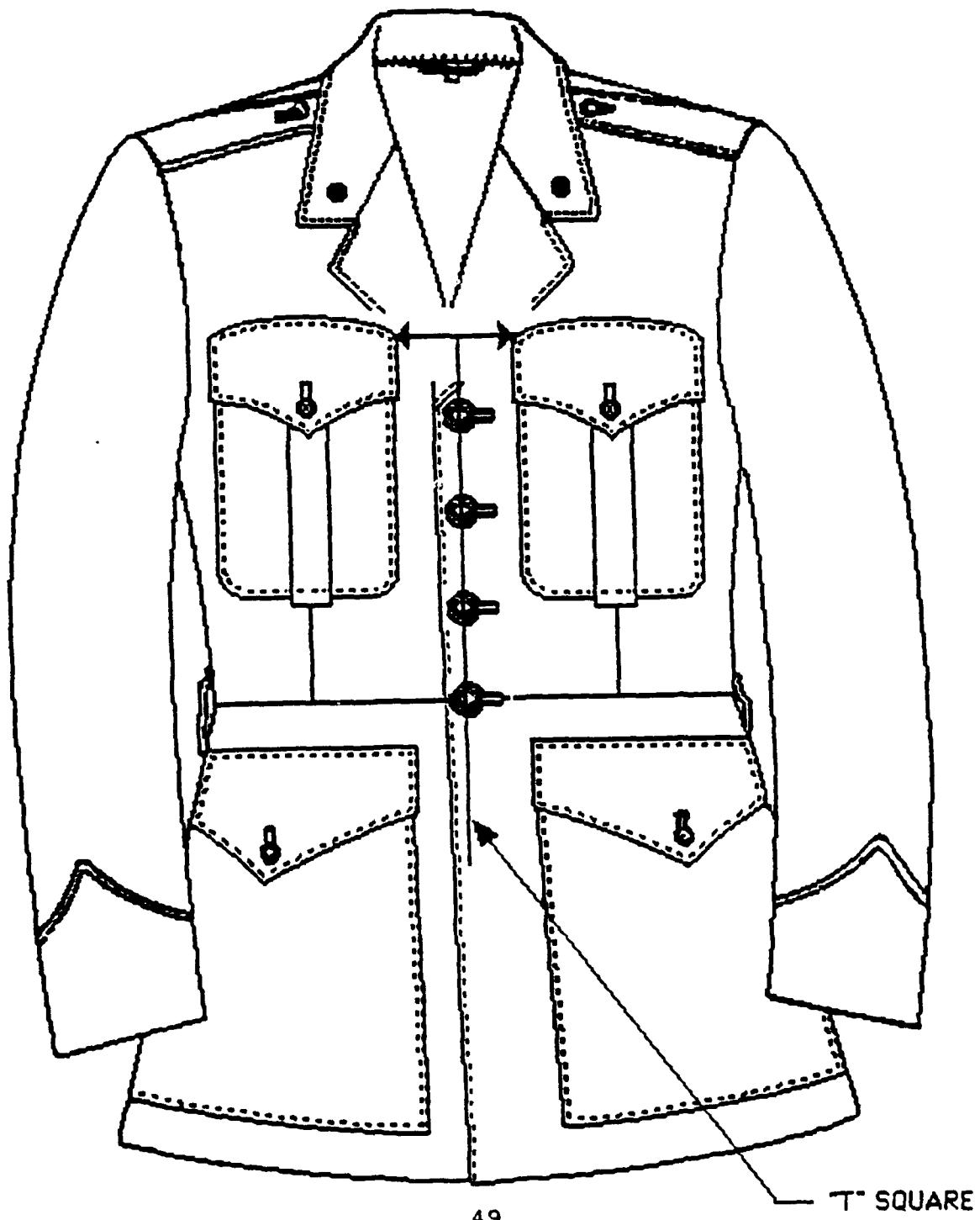
- a) If measurement $A_1=A_2=A_3$, then the left breast pocket is in perfect vertical alignment with the left lower patch pocket.
- b) If measurement $A_1=A_2$, but varies more than $3/16"$ with A_3 , then the left breast pocket is not in vertical alignment with the left lower patch pocket and is scored as a selected defect.
- c) If $A_1=A_2$, but varies less than $3/16"$ with A_3 , then the left breast pocket is considered to be in vertical alignment with the left lower patch pocket and no defect points are assigned.

Final Report: Military Dress
Coat Alignment Problem, Phase I

- d) If measurement $B1=B2=B3$, then the right breast pocket is in perfect vertical alignment with the right lower patch pocket.
- e) If measurement $B1=B2$, but varies more than $3/16"$ with $B3$, then the right breast pocket is not in vertical alignment with the right lower patch pocket and is scored as a selected defect.
- f) If $B1=B2$, but varies less than $3/16"$ with $B3$, then the right breast pocket is considered to be in vertical alignment with the right lower patch pocket and no defect points are assigned.

FIGURE XII

VERTICAL ALIGNMENT OF BREAST POCKETS WITH
FRONT EDGES OF THE FLAPS OF THE LOWER PATCH POCKETS

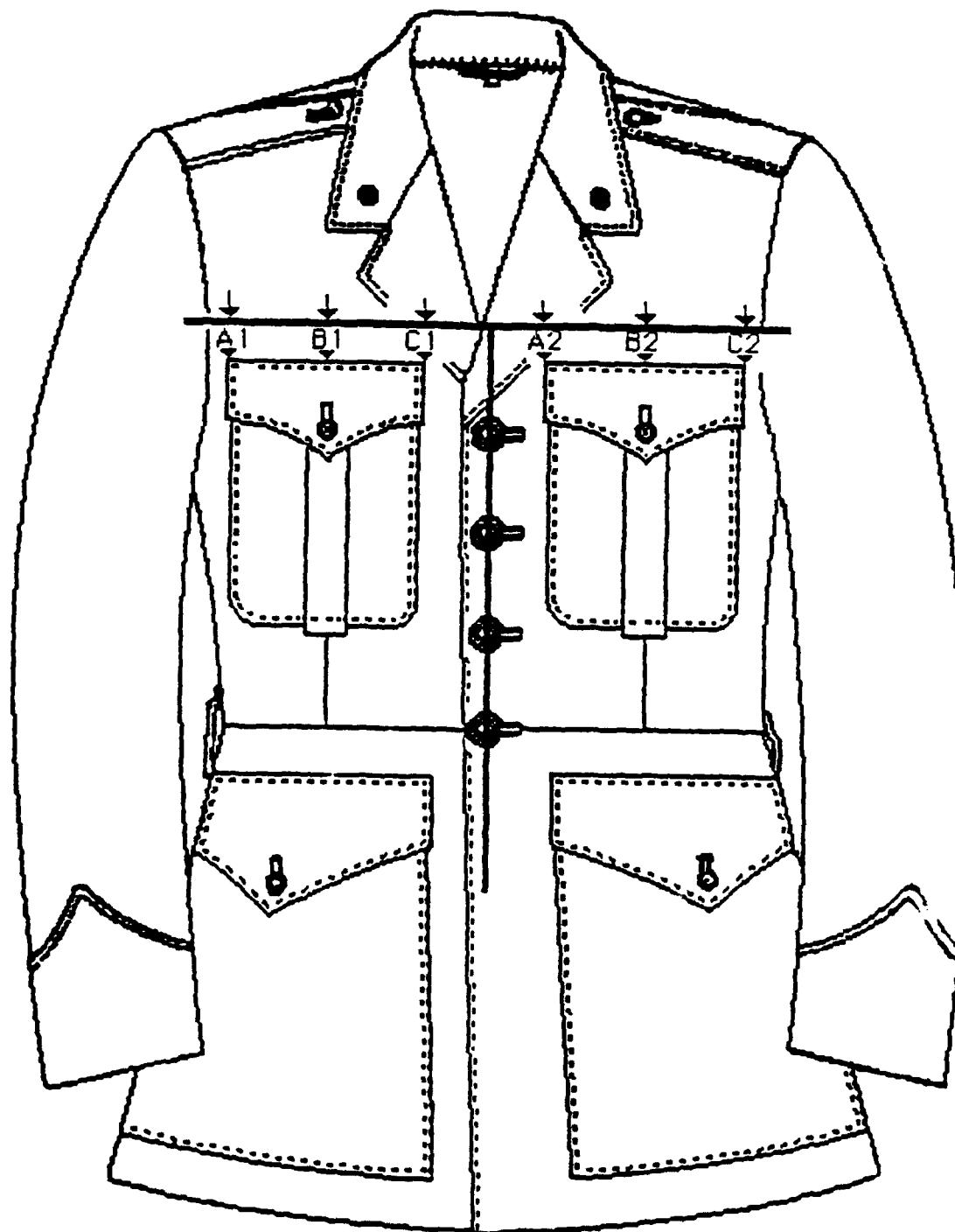


Final Report: Military Dress
Coat Alignment Problem, Phase I

The statement in the Standard, "upper front corner of lower patch pocket not set back 1/8" and the lower corner of the pocket not set back 3/8" from the above vertical alignment" is also confusing and should be accompanied by a diagram, such as Figure XIII: SLOPE OF LOWER PATCH POCKET, with a supplemental text such as:

- a) the 1/8" illustrated on the diagram represents the horizontal measurement of the upper left corner (as viewed on the diagram) of the lower patch pocket from the left top corner of the flap.
- b) the distance Z should be equal to the distance X plus 3/8", or mathematically stated: $Z=X+3/8"$.

FIGURE XIII
SLOPE OF LOWER PATCH POCKET



A major problem with this particular section is that there is zero tolerance as regards the lower patch pocket. The measurement Z can be off by only 1/32" and still be scored as a selected defect which could result in the rejection of the entire lot. A measurement of 1/32" is minute in terms of garment manufacturing, yet under the Standard a selected defect will still be scored. The project team is of the opinion that in this instance there should be some tolerance (+/- a specific amount) but a tolerance small enough so as not to adversely effect the esthetics of the garment. This allows the manufacturer some leeway and should result in less rejects without any material effect upon uniformity of appearance.

* * *

Another section which can be clarified by the use of a diagram:

XIII. POCKET OR FLAP

e. Breast pocket flap: Group A coat

1. Point at center of flap from center of

pocket pleat:

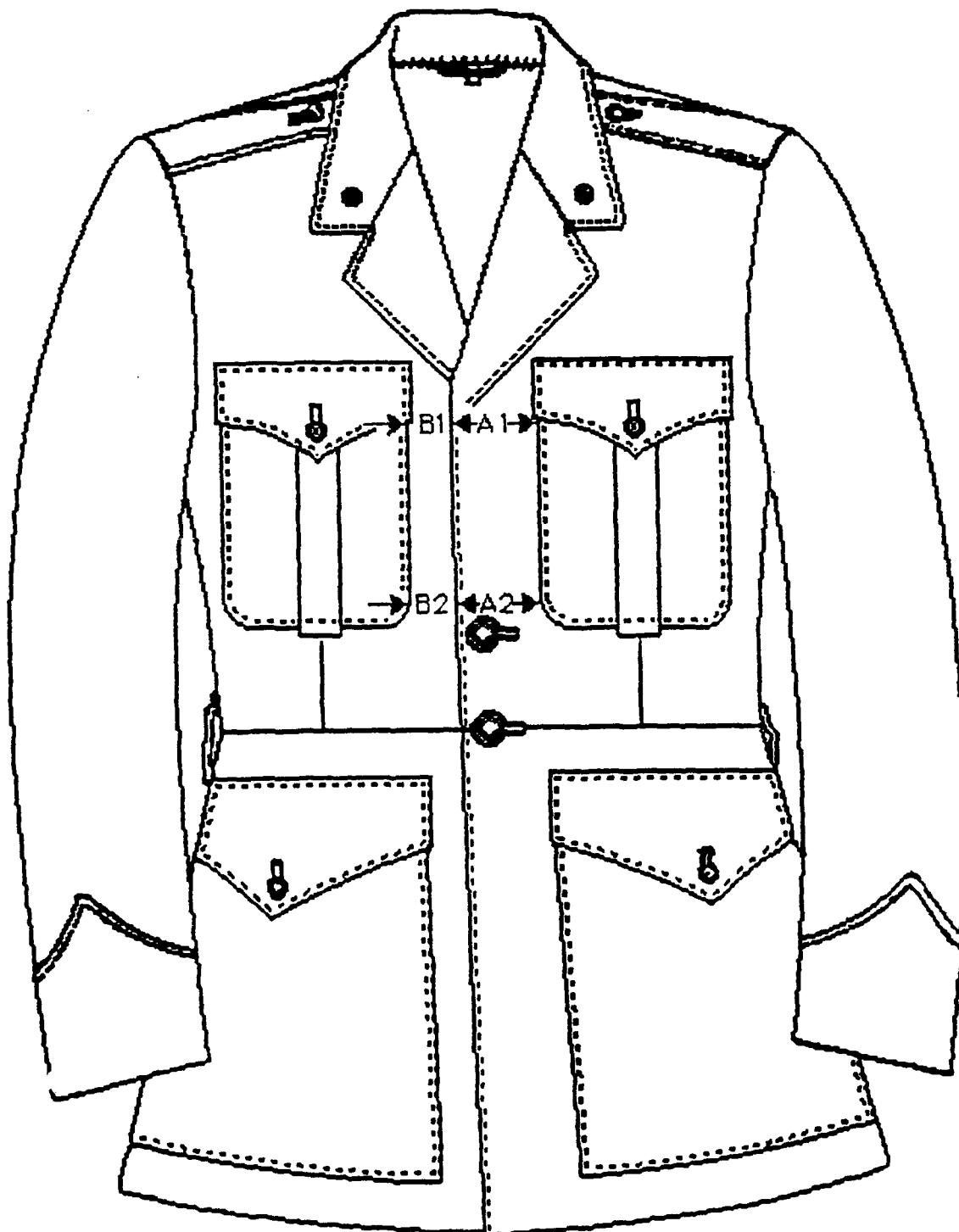
a. more than 1/8" to 1/4" inclusive....1
point

b. more than 1/4"....2 points

Referring to Figure XIV: CENTERING POINT OF BREAST POCKET FLAPS, the section can be rewritten to state:

- a) If X varies from Y by 1/8" up to 1/4" inclusive, then one defect point is assigned.
- b) If X varies from Y by more than 1/4", then two defect points are assigned.

FIGURE XIV
CENTERING POINT OF BREAST
POCKET FLAPS



* * *

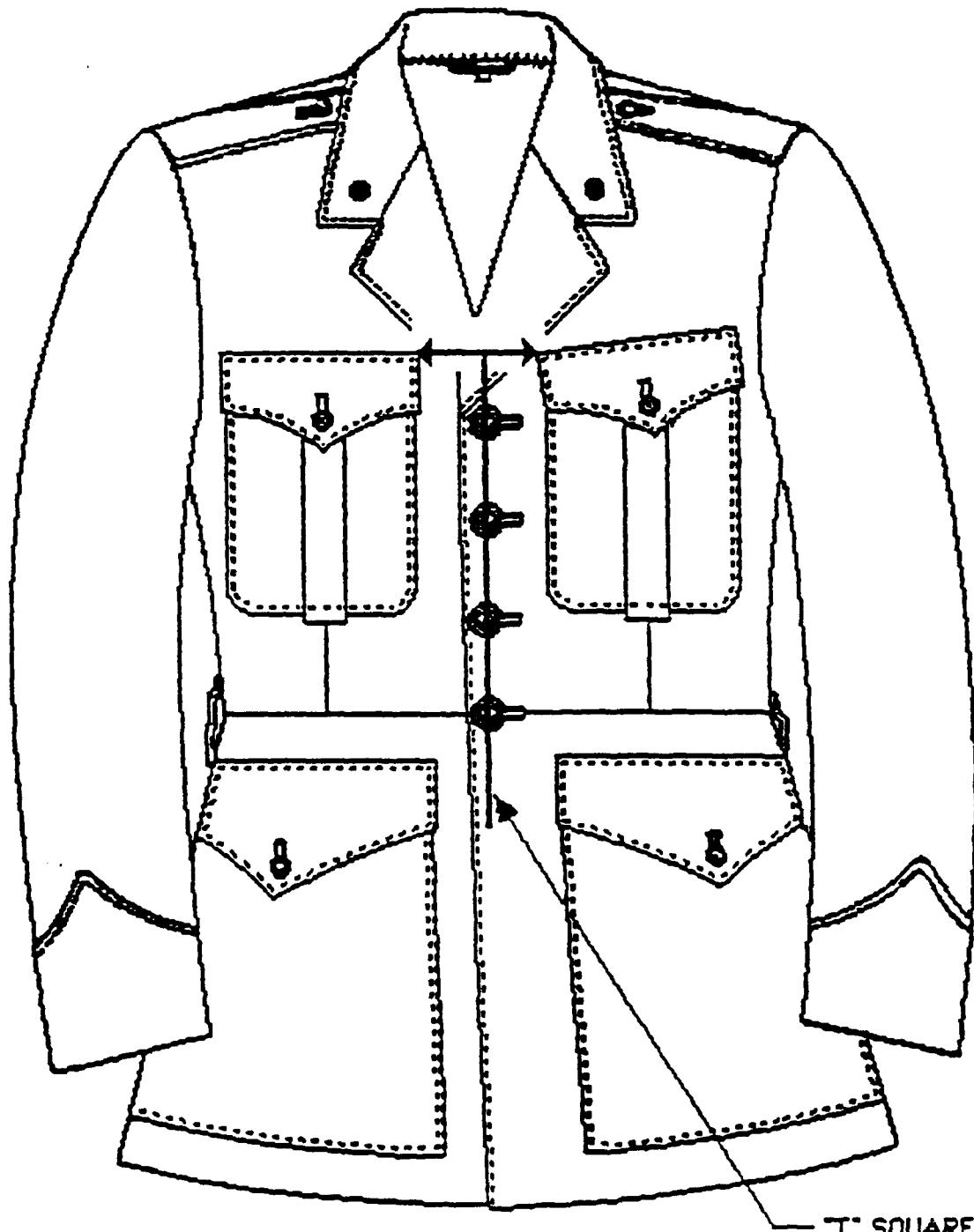
The following section can also benefit from a diagram to illustrate the proper measurements.

XIII. POCKET OR FLAP

- e. Breast pocket flap: Group A coat
 - 4. Flap not in horizontal alignment (Group A Marine Corps coats only)
 - a. More than 1/4"....(*selected defect)
 - b. More than 1/8" up to 1/4" inclusive....3 points

The major problem with this section is that it doesn't state how to measure the horizontal alignment of the flaps. Should the inside corners be measured or the outside corners? Should the entire top portion of the flaps be in alignment? This is potentially confusing and could lead to different results being obtained in different locations. During our visits to the various inspection/manufacturing sites it was noted that the common practice is to measure only the inside corners of the flaps to determine conformity. Referring to Figure XV: INSIDE CORNERS OF BREAST POCKET FLAPS IN ALIGNMENT, OUTSIDE CORNERS OUT OF ALIGNMENT, it can be readily seen that the inside corners are in alignment, per the accepted practice, and the coat is acceptable. However, the outside corners are not in alignment and the coat should not be accepted.

FIGURE XV
INSIDE CORNERS OF BREAST POCKET FLAPS
IN ALIGNMENT, OUTSIDE CORNERS
OUT OF ALIGNMENT



* * *

In Figure XVI: INSIDE CORNERS OF BREAST POCKET FLAPS IN ALIGNMENT, FLAPS ROUNDED, we again see that the inside corners are in horizontal alignment; but is this coat acceptable? It is the opinion of the project team that a much more precise technique should be utilized to measure the horizontal alignment of the breast pocket flaps. It is recommended, see Figure XVII, RECOMMENDED MEASUREMENTS TO DETERMINE HORIZONTAL ALIGNMENT OF BREAST POCKET FLAPS, that the following method be utilized:

- a) If $A_1=A_2$, $B_1=B_2$, and $C_1=C_2$; then the breast pocket flaps are in horizontal alignment.
 1. The A distances do not have to equal the B or C distances, nor do B or C distances have to equal each other.
 2. The measurements (A, B, or C) can be predetermined to allow the proper slope of the flaps.

For example,

- a. If the flaps are to be perfectly horizontal, then $A_1=A_2=B_1=B_2=C_1=C_2$.
- b. If the flaps are to have an upwards or downward slope to the outside, then $A_1=C_2$, $B_1=B_2$, $C_1=A_2$.

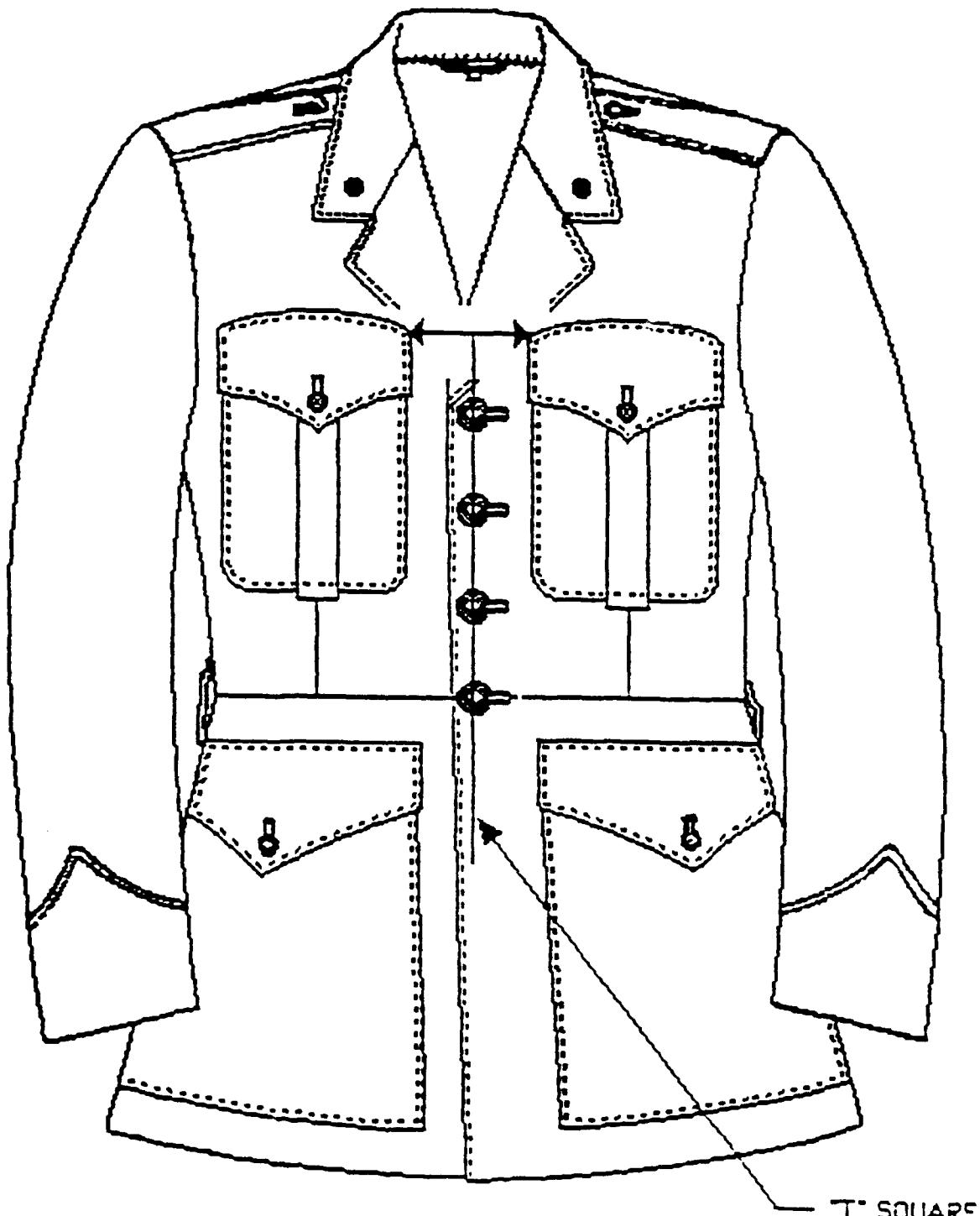
Final Report: Military Dress
Coat Alignment Problem, Phase I

b) Tolerances should also be included. If the flaps are to be perfectly horizontal, the same tolerances can be utilized; that is:

1. If any of the measurement points vary by more than 1/4".....*selected defect
2. If any of the measurement points vary by more than 1/8" up to 1/4" inclusive.....3 points

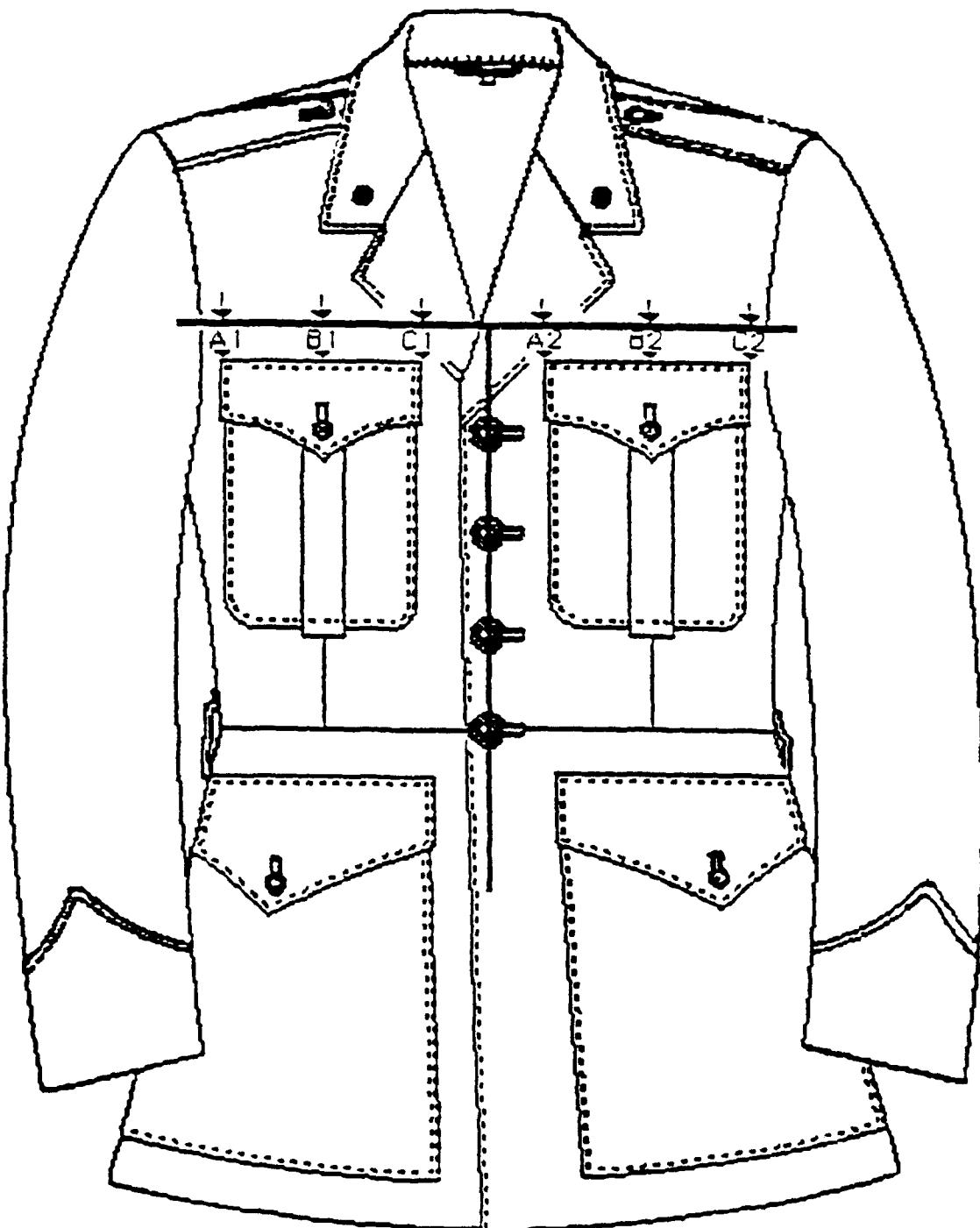
c) If there is to be a slope then tolerances would have to be stated for similar measurements on left and right flaps.

FIGURE XVI
INSIDE CORNERS OF BREAST POCKET FLAPS
IN ALIGNMENT, FLAPS ROUNDED



T-SQUARE

FIGURE XVII
RECOMMENDED MEASUREMENTS TO
DETERMINE HORIZONTAL ALIGNMENT OF
BREAST POCKET FLAPS

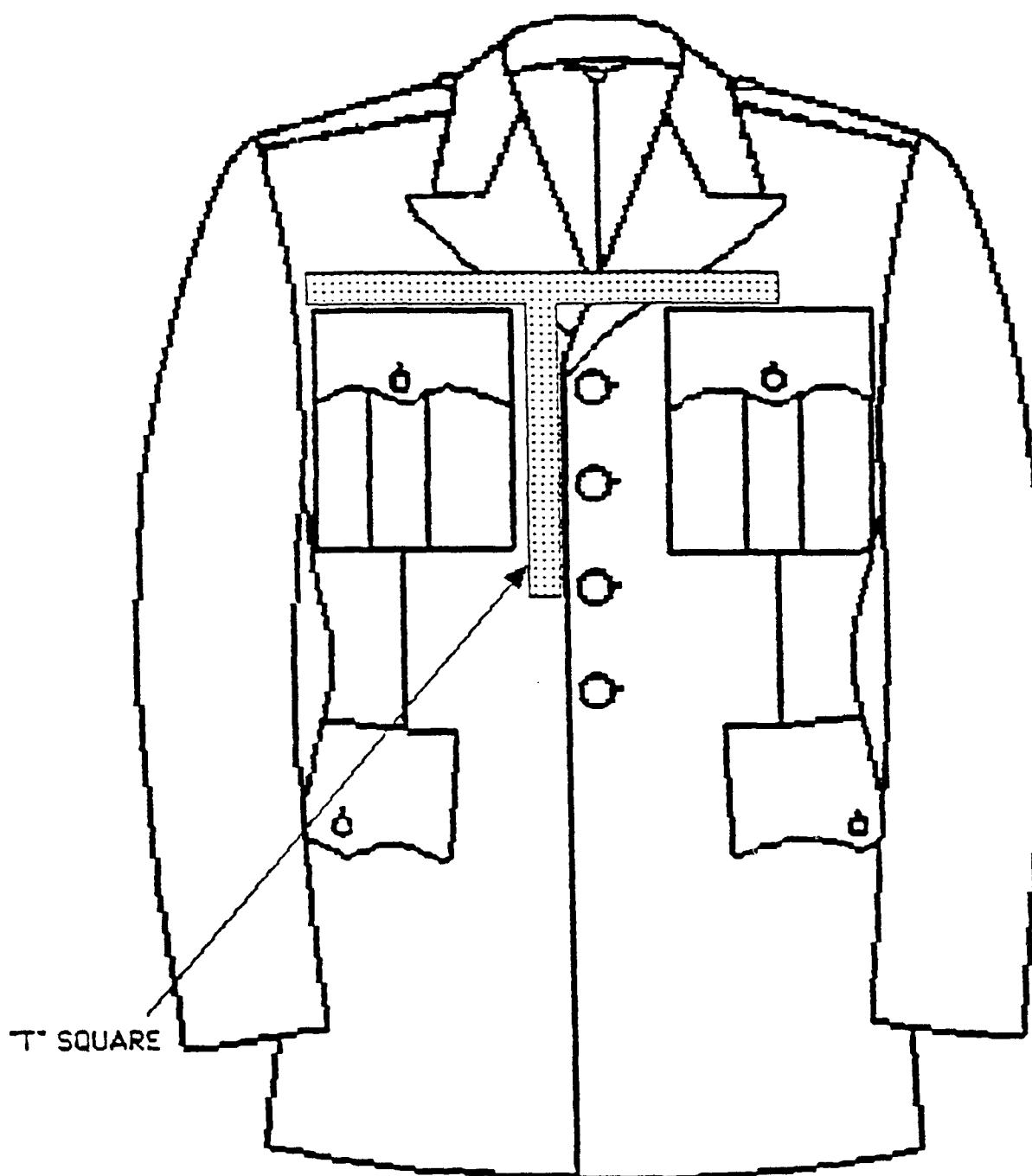


The project team believes that the recommended technique will yield more uniform results and allow very little room for interpretation.

* * *

The specifications for the Army/Air Force coats state that the "top edge of the breast pocket flaps shall be at a right angle with the front edge of the coat when buttoned". This however, is not mentioned in MIL-STD-1490F and the project team is of the opinion that it should be. Figure XVIII, TOP EDGE OF BREAST POCKET FLAPS AT RIGHT ANGLES WITH FRONT EDGE OF COAT WHEN BUTTONED, illustrates how a diagram of an Army/Air Force coat can be utilized to determine if the top edge of the breast pocket flaps are at right angles with the front edge of the coat when buttoned. The "T" Square is utilized to assure that a right angle is maintained within stated tolerances.

FIGURE XVIII
TOP EDGE OF BREAST POCKET FLAPS AT
RIGHT ANGLES WITH FRONT EDGE OF COAT
WHEN BUTTONED



* * *

The following section is typical of how a diagram can be helpful in understanding the inspection procedure.

XIII. POCKET OR FLAP

f. Breast pocket: Group A coat

1. Side pocket not parallel with front edge of coat by: (See Note 5).

a. more than 3/8".....3 points

b. 1/4" up to 3/8".....2 points

Note 5: Measure from straight edge of coat to front edge of pocket at top (immediately below flap), and also at bottom of pocket. Any differences between measurements is the amount pocket is not parallel with front edge

This section is confusing. Line f talks about the breast pocket and then line f.1 talks about the side pocket. It is not clear whether reference is to the breast pocket, the side pocket, or both. In interviews with several inspectors we were given to understand that the document is referring to the breast pocket. It is our recommendation that line f.1 should be changed to read: "Breast pocket not parallel with front edge of coat by..." Note 5 instructs the inspectors to measure

Final Report: Military Dress
Coat Alignment Problem, Phase I

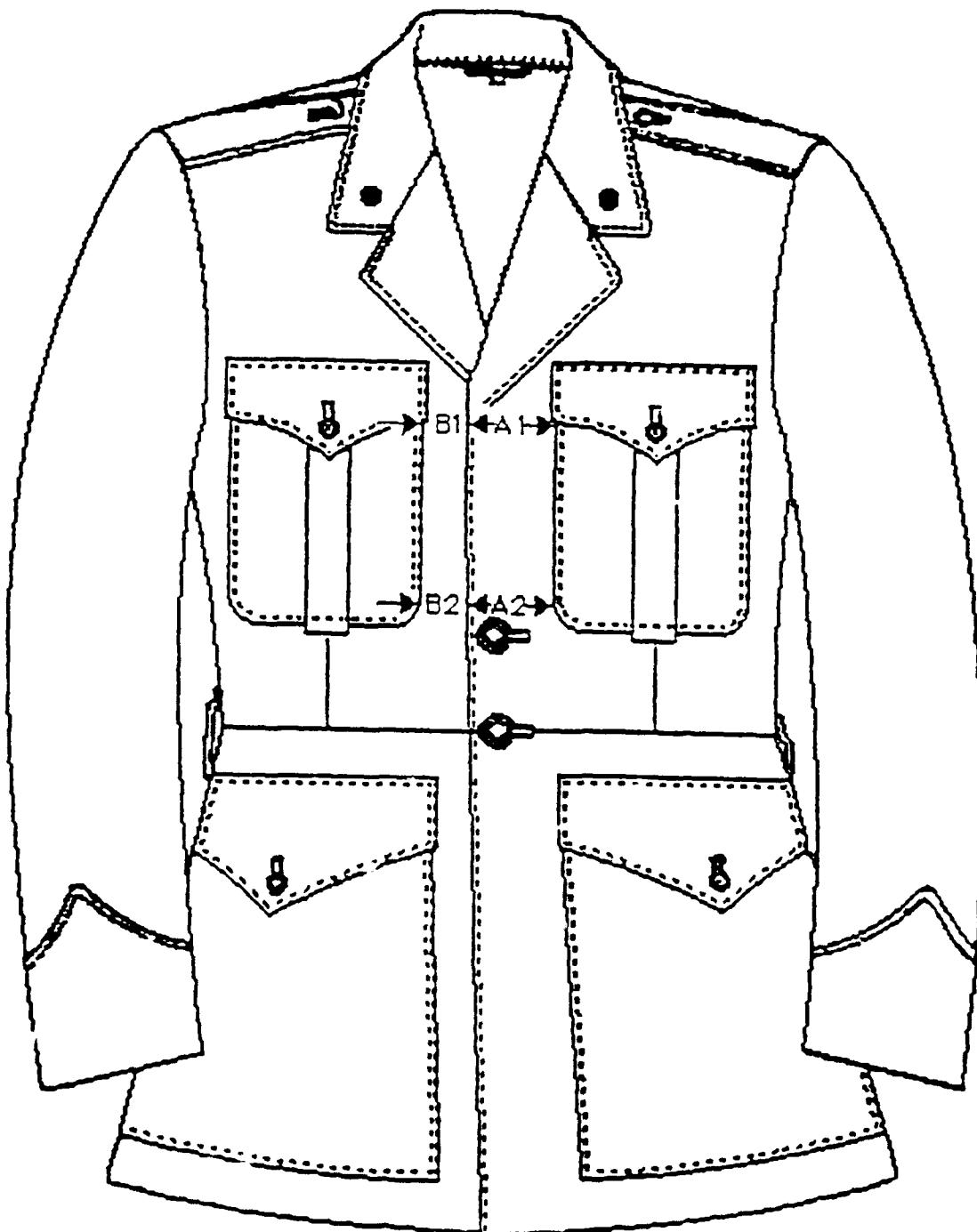
from the straight edge of the coat to the front edge of the pocket at top (immediately below the flap) and also at the bottom of the pocket. Since the lower corners of the breast pockets are curved, it is not clear as to exactly where this measurement should be taken and this section is, therefore, open to interpretation. This section also refers to "pocket", which is singular, thereby creating doubt whether reference is to the right, left, or both breast pockets. The project team recommends that a diagram, such as Figure XIX, RECOMMENDED MEASUREMENTS TO DETERMINE PARALLELISM OF BREAST POCKETS TO FRONT EDGE OF COAT, accompany this section to eliminate the ambiguities that exist. There are four measurements to be made: A1, A2, B1, and B2. The A measurements concern the parallelism of the left breast pocket relative to the front edge of the coat while the B measurements concern the parallelism of the right breast pocket relative to the front edge of the coat.

Although Figure XIX illustrates a Marine Corps coat, the same technique can be utilized for Army and Air Force coats as well.

Final Report: Military Dress
Coat Alignment Problem, Phase I

Instructions accompanying Figure XIX might be as follows. If A1 varies from A2 by more than $3/8"$, then three defect points are assigned. If A1 varies from A2 by $1/4"$ up to $3/8"$, then two defect points are assigned. If A1 varies from A2 by less than $1/4"$, then no defect points are assigned. The same rationale can be applied to the B measurements. Notice that the A1 and B1 measurements are made immediately below the flap. The A2 and B2 measurements are made at the point where the pockets start to curve.

FIGURE XIX
RECOMMENDED MEASUREMENTS TO
DETERMINE PARALLELISM OF BREAST POCKETS
TO FRONT EDGE OF COAT



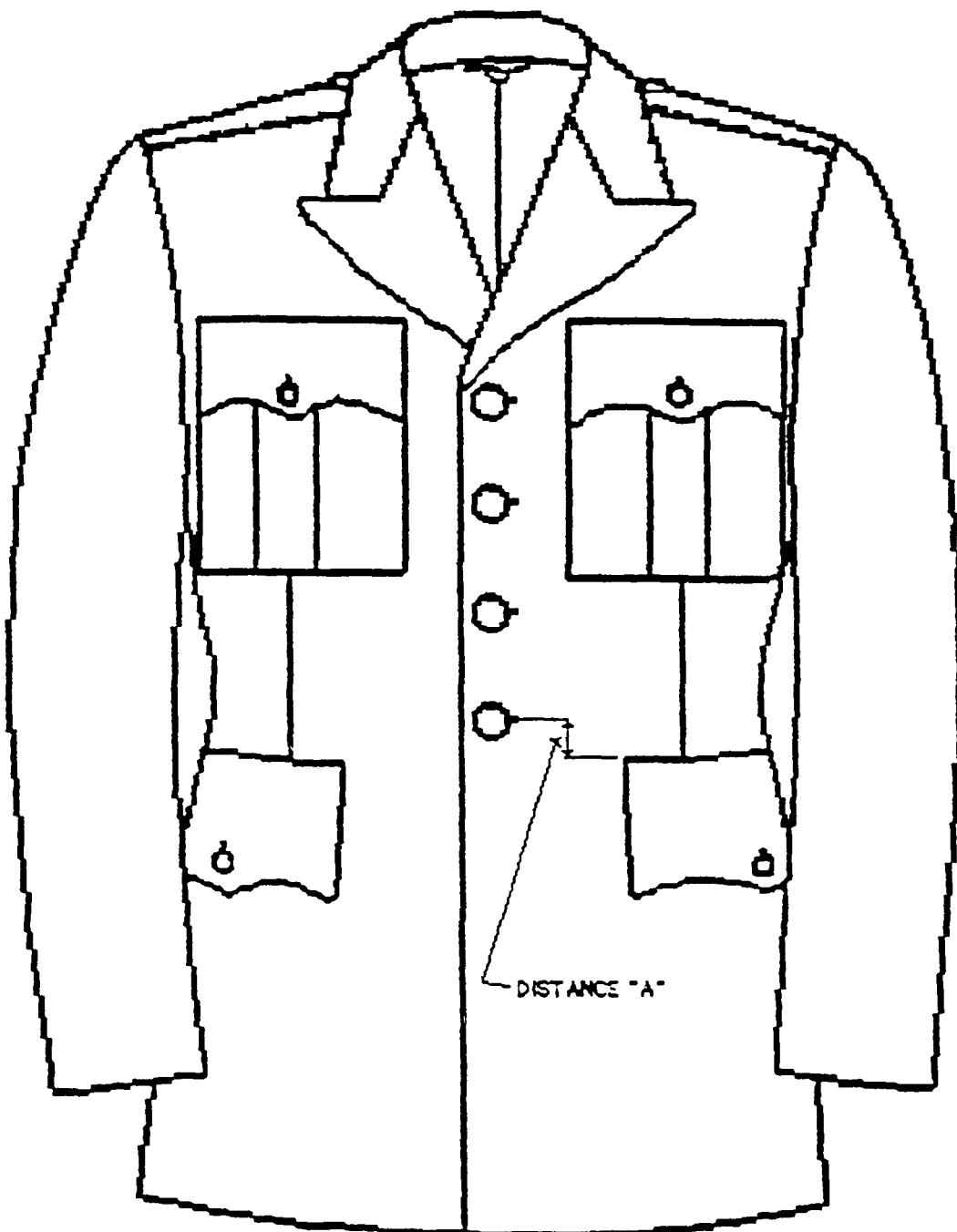
* * *

There is mention in the Army and Air Force specifications that the bottom buttonhole of the front shall be positioned 3/4" to 1" above the top edge of the lower pocket flaps. This does not appear in MIL-STD-1490F but the project team believes it should be measured in the inspection process and could be made clear by the use of a diagram such as Figure XX, POSITION OF BUTTONHOLE. The distance "A" could be given as either 3/4" or 1", and plus or minus tolerances would also be established.

* * *

Throughout the inspection process selected defects should be those that require a major undertaking to repair or those that can't be repaired at all. Any defect that can be easily repaired should not be scored as a selected defect. Simple operations such as the movement of a button to alleviate an alignment problem should be considered a repairable defect whereas only major operations such as the removal of the seam that joins the lower portion of the Marine Corps coat to the upper portion so that vertical alignment can be achieved should be classified as selected defects. By so doing, the efficiency and effectiveness of manufacturing and inspection processes would be improved.

FIGURE XX
POSITION OF BOTTOM FRONT BUTTONHOLE



MANUFACTURING TECHNIQUES

At all the manufacturing locations visited, the marking of pocket placement was performed on the left and right fronts separately but accomplished in pairs. First one side was marked and then the other. Three reference points were utilized to align the top pocket: the shoulder, armhole notch, and front step. Another three points were utilized to align the lower patch pocket. These were the top pocket, the notch on the skirt, and the waist join seam on the Marine Corps coat. Given the state-of-the-art today, this method is the best approach for locating the pocket placement. It requires, however, that the people doing the marking be extremely accurate when aligning the reference points, as any error will be transmitted to pocket misalignment.

The project team recommends the use of negative patterns (pocket position removed from the pattern) or cut outs. Also, it is recommended that a white marking pencil with a sharp point should be specified for use when marking around the edge of the pocket outline. The use of tailor's chalk for this purpose should be discouraged. It is more difficult to maintain an even-width line with tailor's chalk which, in use, tends to thicken more quickly than does a pencil and can in this way result in inaccuracies when marking. In addition, the chalk is more difficult to sharpen than the pencil.

Final Report: Military Dress
Coat Alignment Problem, Phase I

Marking of pocket placement by use of negative patterns gives the sewing operator a full outline of the pocket on the face of the garment to use as a guide when setting the pocket. When the question of whether to mark with a half or full set of patterns (fronts) arises, we recommend the full set method because in that way both pockets are marked at the same time. This technique also tends to improve the chances of perfect vertical alignment as the operator has a visual reference for comparison of one pocket to another.

In the case of the Marine Corps coats, when the pockets are set prior to waist seam joining the marking of the pockets must be extremely accurate. The only placement guide that the sewing operator will have is the outline of the individual pocket (either the top or lower front pocket) without the benefit of the other pocket. Because of the greater potential for pockets to be out of alignment, it is strongly recommended that when the waist seam joining operation is performed after the pockets have been set, inspection be performed immediately afterwards. Since the coat manufacturers have the option of marking pocket placements in any one of several ways it is critical that inspection take place after each step in the process from marking through pocket and flap setting and subsequent operations.

The marking of pocket locations and their correct placement by the sewing machine operator are the two most critical parts of pocket alignment. It is also apparent that poor marking, cutting, and setting of the front facing can also adversely affect alignment. Therefore, it is imperative that employees be well trained in all the requisite techniques. Proper managerial skills are also important to insure accuracy in the manufacture of these products as related to pocket alignment. Managements must ensure that all personnel are adequately trained, whether they will be marking the fronts or sewing on the pockets and flaps. Only in this way can the production of top quality garments be assured.

The project team recommends that constant in-process supervision be maintained in order to guarantee accurate and precision workmanship. To repeat, it is strongly recommended that in-process inspections be conducted after each step in the marking and sewing operations of the pockets and flaps.

It cannot be stated too strongly that precision is absolutely required in order to guarantee proper placement and alignment of pockets and pocket flaps. It must also be understood that textile products are not dimensionally stable, they will stretch (grow) or shrink due to even minor changes in environmental conditions. Their dimensions are also subject to change during normal handling and/or while in storage or when

Final Report: Military Dress
Coat Alignment Problem, Phase I

being shipped. This is particularly true when dealing with fabrics that contain natural fibers. Consequently, allowances for these changes must be built into the manufacturing and inspection tolerances.

SUMMARY

The major problem areas encountered in this project were the model forms used to examine the finished garments, the "T" Squares used to measure the horizontal and vertical alignment of the pockets, pocket flaps, buttons and buttonholes, and MIL-STD-1490F, Military Standard, Provisions for Evaluating Quality of Coats, Men's, Dress, and the manufacturing techniques practiced by the various Government contractors and/or called for by the applicable garment specifications.

The problems with the model forms are as follows:

1. The size range of garments being examined on each of these forms is too great;
2. The forms produced by different manufacturers are not exactly the same, although their body measurements do conform to the requirements of the applicable specifications;

3. There are insufficient reference points marked on the forms to assist the inspectors when "dressing" the forms; and,
4. The condition of the forms, relative to their state of repair, varies widely and should be periodically inspected to make sure they continue to meet specifications.

The problems with the "T" Square are:

1. There are too many markings on the device. It is therefore, difficult to obtain accurate readings;
2. The smoke gray color makes it difficult to see the various components of the garment being inspected;
3. The "T" Squares with the yellow markings are almost impossible to use as they obscure the pockets and flaps which are to be measured; and,
4. The "T" Square is not used in the same manner by all inspectors.

The problems uncovered in the use of MIL-STD-1490F, Military Standard, Provision for Evaluating Quality of Coats, Men's, Dress are:

1. The text is often difficult to understand;
2. The text, in many cases, is open to various interpretations;

3. The language is sometimes ambiguous;
4. There is an absence of any illustrations or diagrams; and,
5. The point/select defect system does not allow for minor repairs.

RECOMMENDATIONS

The project team's recommendations, after careful consideration and analysis, are presented in three groups: Short Term; Medium Range; and Long Term. It is strongly suggested that all the recommendations be implemented.

SHORT TERM RECOMMENDATIONS

Model Forms

1. New determinations should be made with reference to resolving the question of which size forms are appropriate for extra short, short, long, and extra long size garments.
2. Forms purchased from different manufacturers should be standardized and identical in dimensions and all other respects.
3. Forms should be developed that more accurately reflect the actual configuration of military bodies as the Services perceive them.

4. Reference lines should be placed on the forms to assist the inspectors in "dressing" them in exactly the same manner.
5. A Government program should be set up whereby the Government would purchase and own the forms and provide or lease them to the contractors in order to insure the use of correct forms and to monitor their condition.

"T" Square

1. New devices should be developed and issued to the QAR's which are clear and colorless so as to offer maximum transparency.
2. The markings on the new devices should be of a color which will afford the best contrast vis-a-vis visibility against the background of the garments. The markings should be kept to the minimum necessary for QAR inspection purposes.

MIL-STD-1490F

1. The Military Standard should be revised and the text should be improved and, where possible, simplified to eliminate the ambiguities that exist.

Final Report: Military Dress
Coat Alignment Problem, Phase I

2. The text should be clear and precise and not open to interpretation.
3. The use of footnotes should be eliminated as much as possible and any which are necessary should be inserted in close proximity to the text. (On the same page as the text if at all possible).
4. Wherever possible, diagrams should accompany the text.

Manufacturing Techniques

1. The use of negative patterns for marking pocket placement positions is highly recommended. Military dress coat manufacturers should be instructed and encouraged to use this procedure.
2. The use of white marking pencils for marking should be encouraged, whereas the use of tailor's chalk should be discouraged.
3. Wherever possible, the most precise techniques of marking and sewing should be utilized in order to insure proper placement and alignment of pockets, pocket flaps, buttons, and buttonholes.

4. Only qualified personnel should be employed in the prescribed methods to mark and sew these components.
5. In-process inspection systems should be set up if they are not already in place. This will help to insure proper placement of components after each step in the operation.

The project team recognizes that the manufacture of military dress coats is an extremely difficult task, particularly when tolerances are relatively minute. It is also recognized that the fabrics can change dimensions due to climatic or environmental changes and that, therefore, the positioning of the pockets, pocket flaps, etc., can be very demanding. The fact is that a very small error in marking or sewing at the start of manufacturing can be magnified many times over by the time a garment has been finally completed. Any attempts to improve the alignment of pockets, pocket flaps, buttons, buttonholes, etc. must at all times be cognizant of these factors.

It is recommended that immediate action be taken to implement the short term recommendations noted above.

MEDIUM RANGE RECOMMENDATIONS

During the course of this project, the project team encountered some new inspection devices in the commercial market that are already being used or are in their final stages of development. They basically use a computer to inspect specific points of the garment against bench marks or predetermined specifications. With some modification to these measuring devices, the project team believes this kind of inspection system can significantly reduce the subjectivity that is now present in the current procedures.

At the present time there are size-adjustable inspection forms available on the market. In order to be used for the inspection of military dress coats, however, they would have to be modified or reconstructed in order to accommodate the full military size tariff as shown in Tables I and II of MIL-STD-1490F and as reproduced in this report.

The project team recommends that an F.I.T./AAMTD project be initiated to further investigate the feasibility of, and the procedures that would be necessary for, implementing the noted medium range recommendations.

LONG TERM RECOMMENDATIONS

The concept of automating the final inspection of military dress coats and other garments with the assistance of a computer and appropriate sensor and other hardware is deemed, by the research team, to be feasible. The envisioned Computer Assisted Garment Inspection (CAGI) system would maximally utilize an inspector and the types of decisions/judgments the inspector could make accurately and consistently. The CAGI system would provide the inspector with a highly structured set of activities for a step-by-step inspection sequence which would result in go/no-go decisions. Military dress coats would provide a test case for a proof-of-concept system; but the developed system concept could apply to other garments of similar or different types with additional software and appropriate model forms. The potential benefits to the military services initially, and then the civilian market, are considerable. Therefore, it is recommended that consideration be given to this project proposal when submitted by the F.I.T./AAMTD Center.